

# Adapting to a Changing Climate in Southern Florida

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RAND

Climate Resilience Center  
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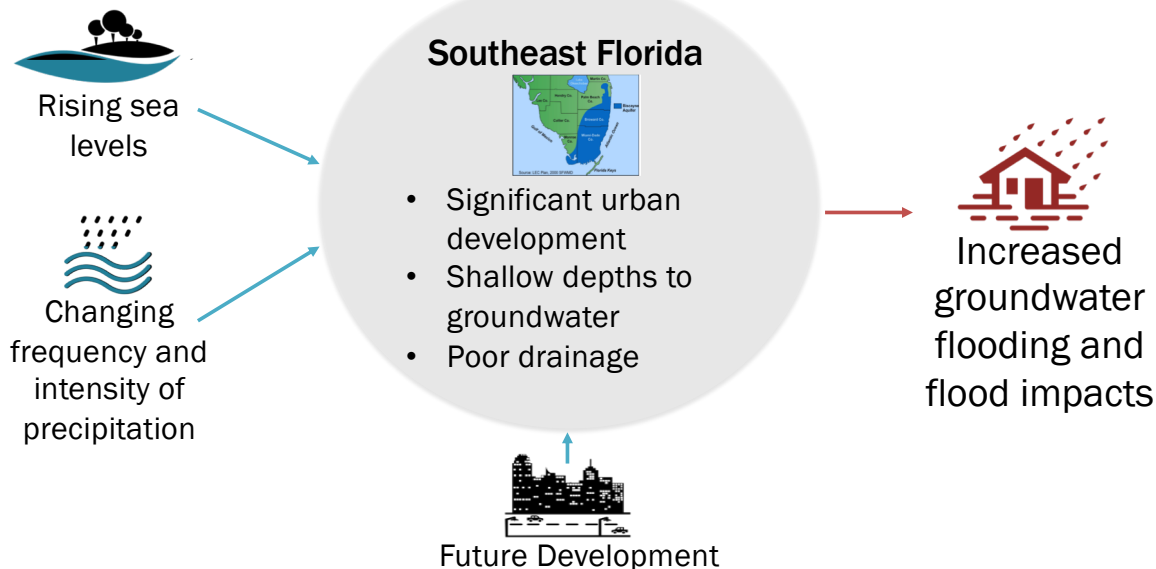
Photo: <https://the-sparkspread.wordpress.com/tag/sunny-day-flooding/>

Collaboration among researchers, county planners, and water resources managers

RAND Corporation	Miami-Dade County	Broward County	SFWMD
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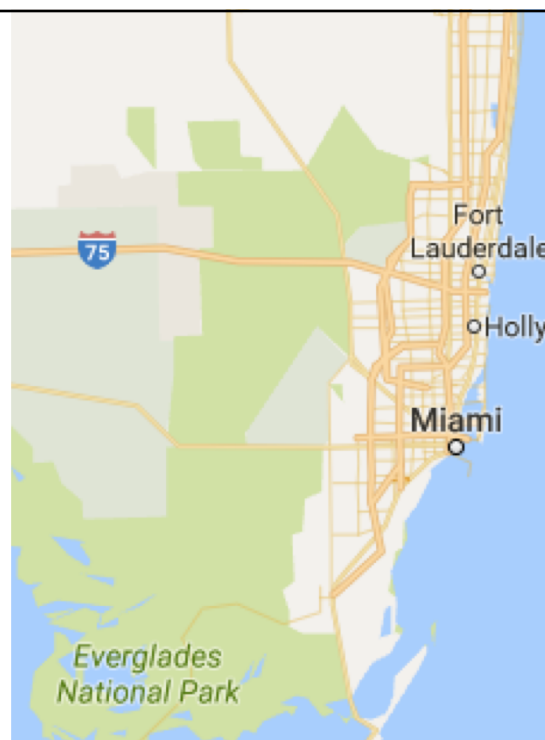
Pilot study funded by: **MacArthur Foundation**

## South Florida faces increasing flood risks from a changing climate and landscape

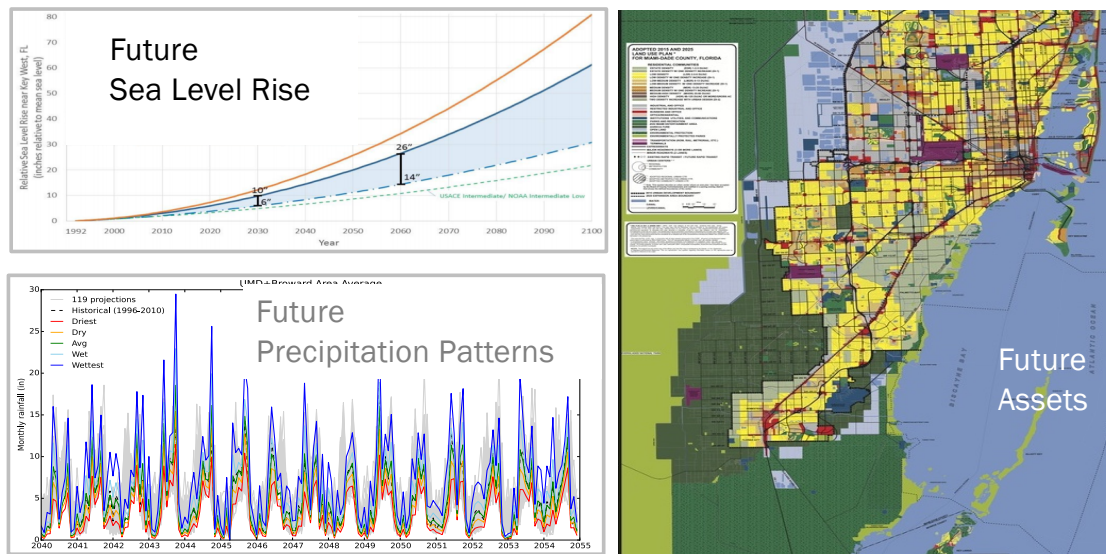


## Key questions addressed in study

- How *vulnerable* is current and planned future urban development in Broward and Miami-Dade Counties to groundwater flooding?
- What are the *key drivers* of future risks?
  - Sea level rise, precipitation, change in assets
- What are the areas of most risk?
- How much risk could be reduced under different adaptations?

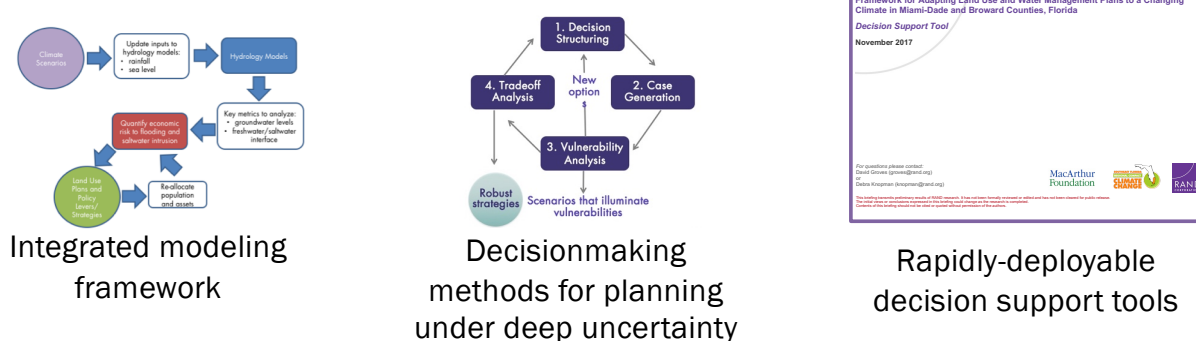


There is uncertainty about the future, which complicates prioritizing risk reduction investments



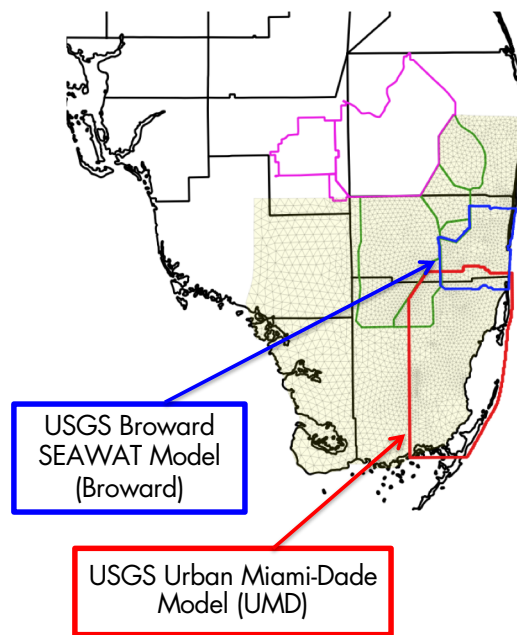
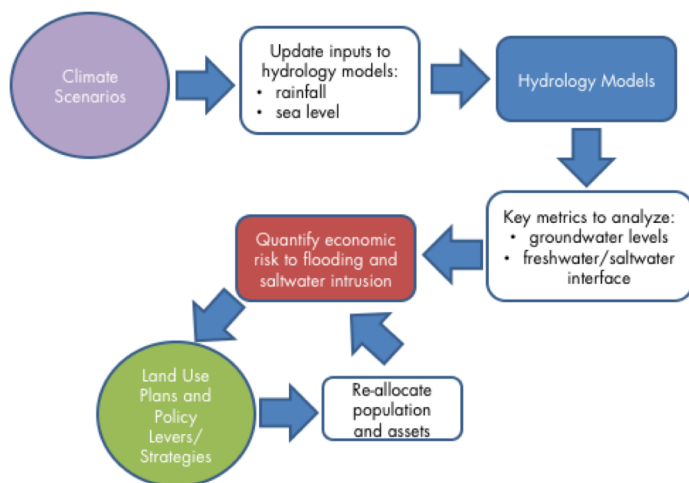
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This study brings together three key elements to help inform adaptation planning

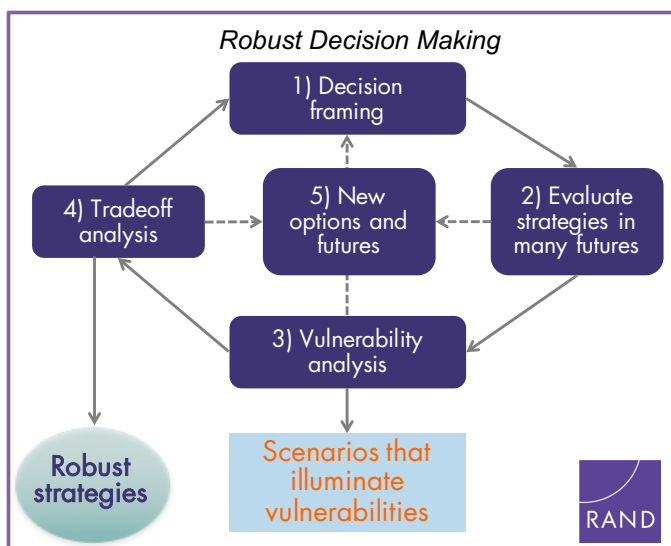


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## 1) Integrated modeling framework evaluates flood risk and land use / asset growth



## 2) Decisionmaking methods for planning under deep uncertainty



- Evaluates numerous plausible future scenarios
- Identifies key vulnerabilities
- Iteratively identifies robust, adaptive strategies



### 3) Rapidly-deployable decision support tools help bring the analysis to partners, stakeholders, and decision makers

#### Framework for Adapting Land Use and Water Management Plans to a Changing Climate in Miami-Dade and Broward Counties, Florida

##### Decision Support Tool

November 2017

For questions please contact:  
David Groves (groves@rand.org)  
or  
Debra Knopman (knopman@rand.org)

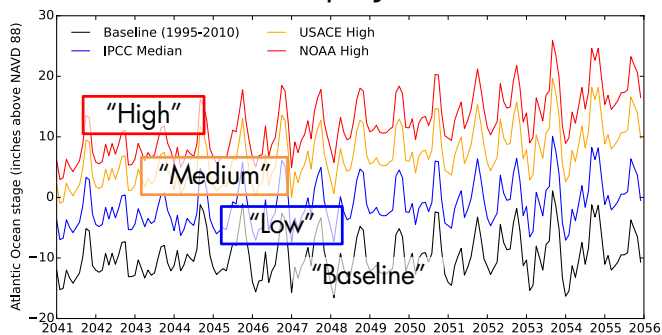
MacArthur  
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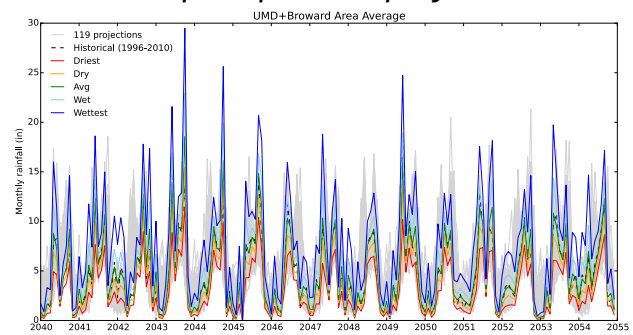
This briefing transmits preliminary results of RAND research. It has not been formally reviewed or edited and has not been cleared for public release. The initial views or conclusions expressed in this briefing could change as the research is completed. Contents of this briefing should not be cited or quoted without permission of the authors.

### 20 scenarios reflect uncertainty about future sea level rise and precipitation patterns

Three sea level rise projections + Baseline

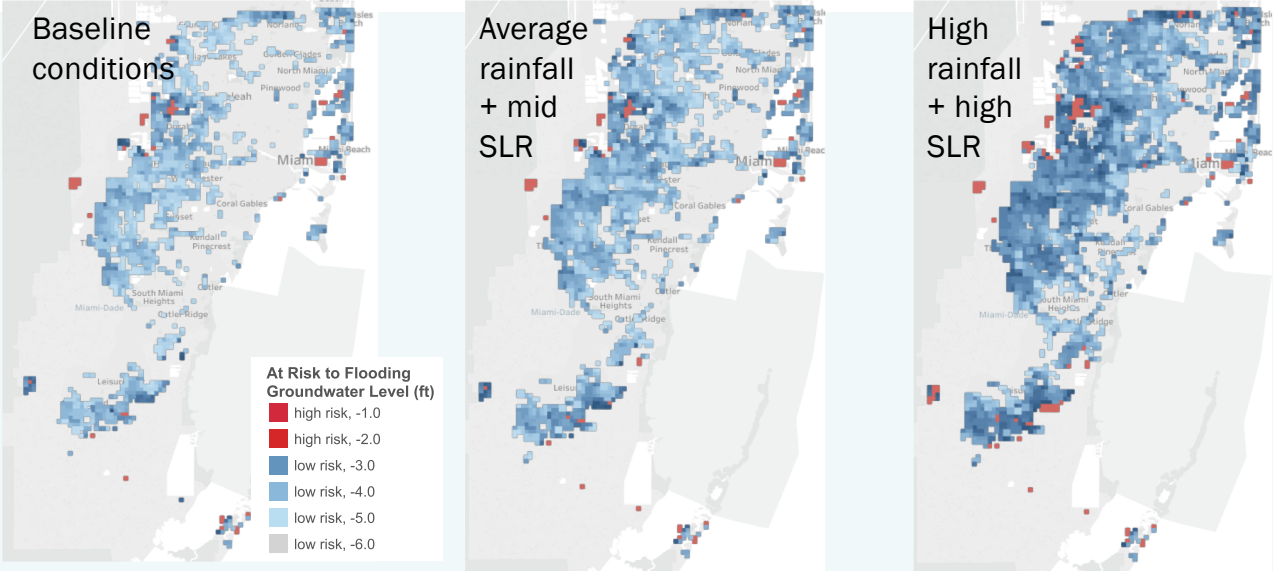


Five precipitation projections

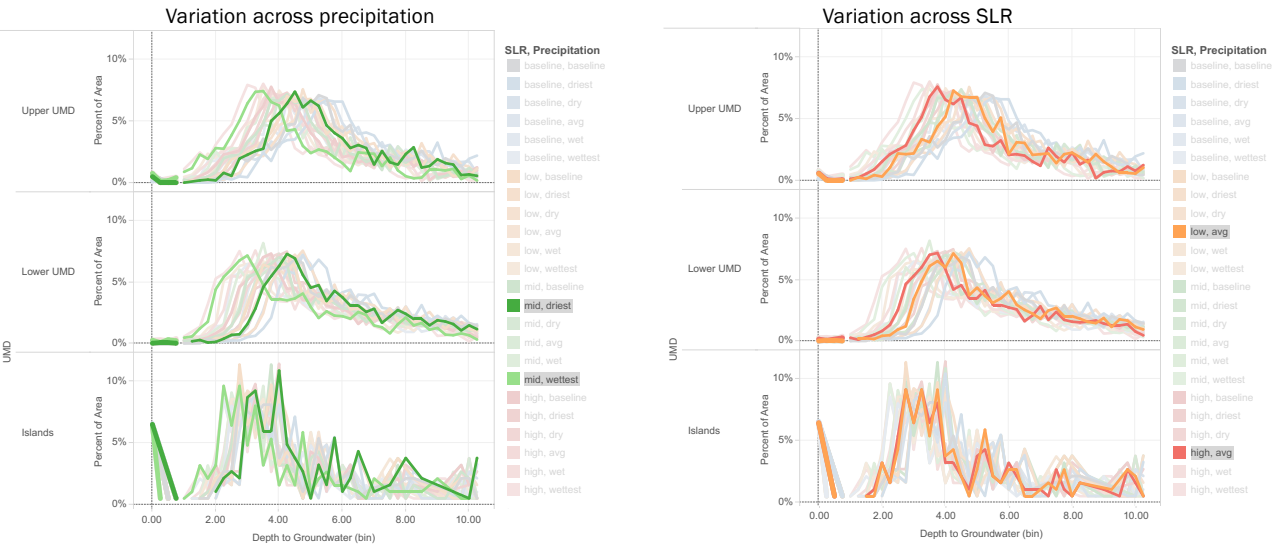


Key hazard metric:

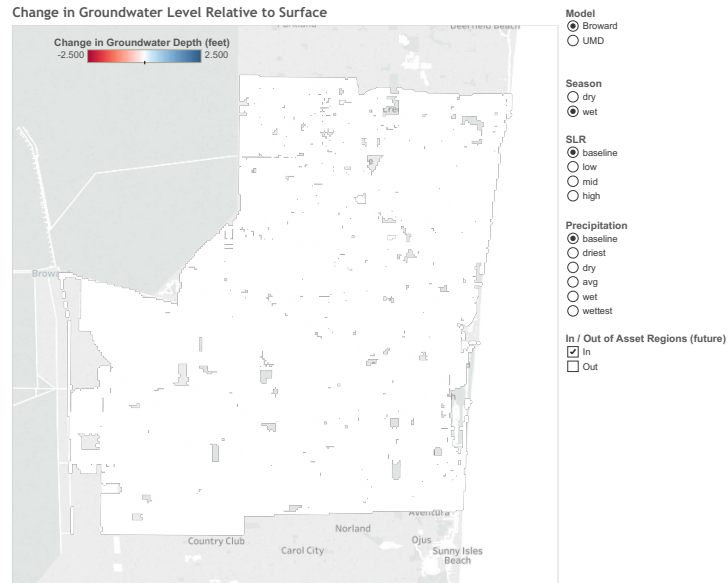
Depth to groundwater for Urban Miami-Dade County



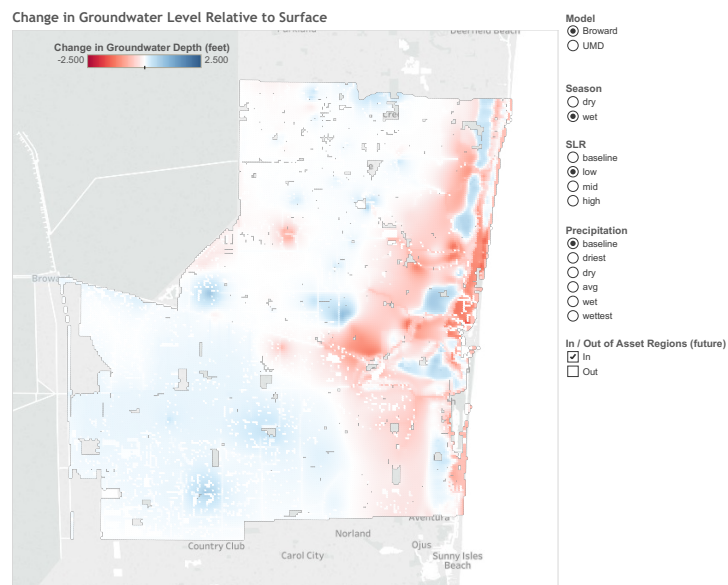
Future precipitation and SLR affect depth to groundwater distributions – Urban Miami-Dade County



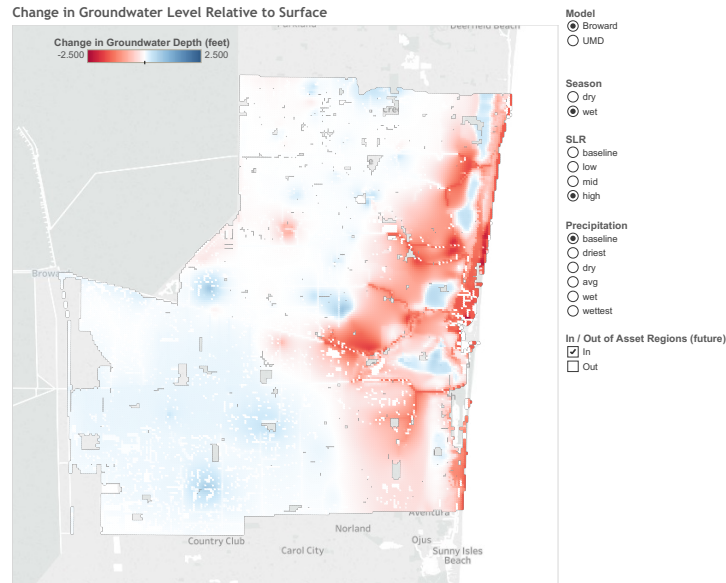
*Which areas of Broward County will be impacted by sea level rise?*



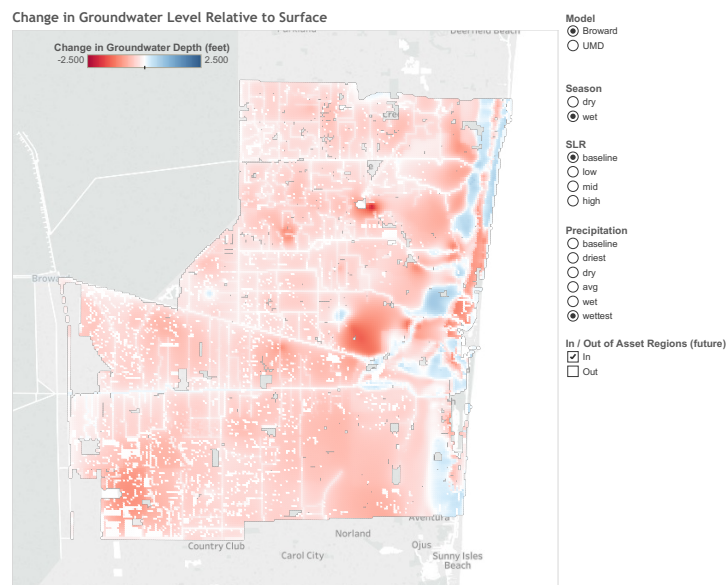
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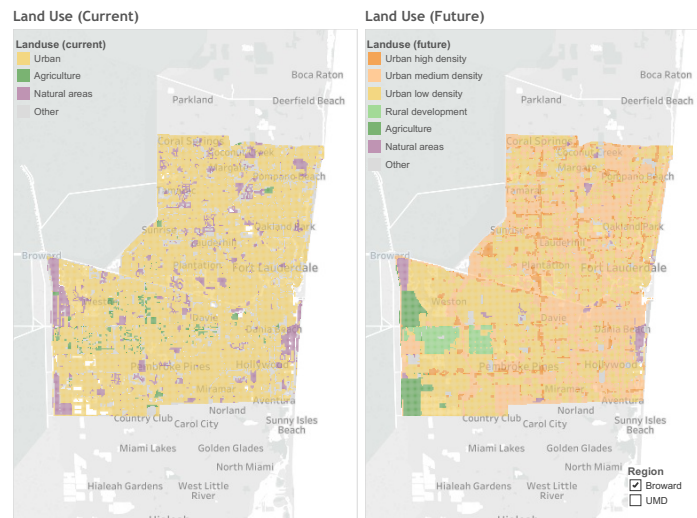
*Which areas of Broward County would be impacted by changes in precipitation?*



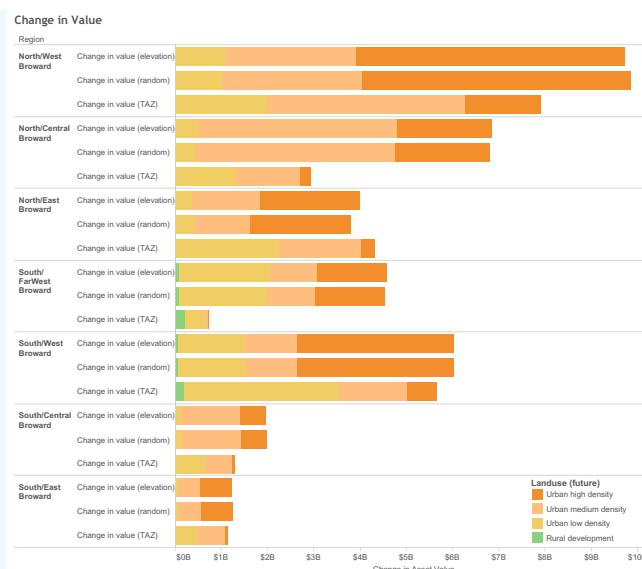


## We developed different estimates of future assets consistent with the region's land use plans

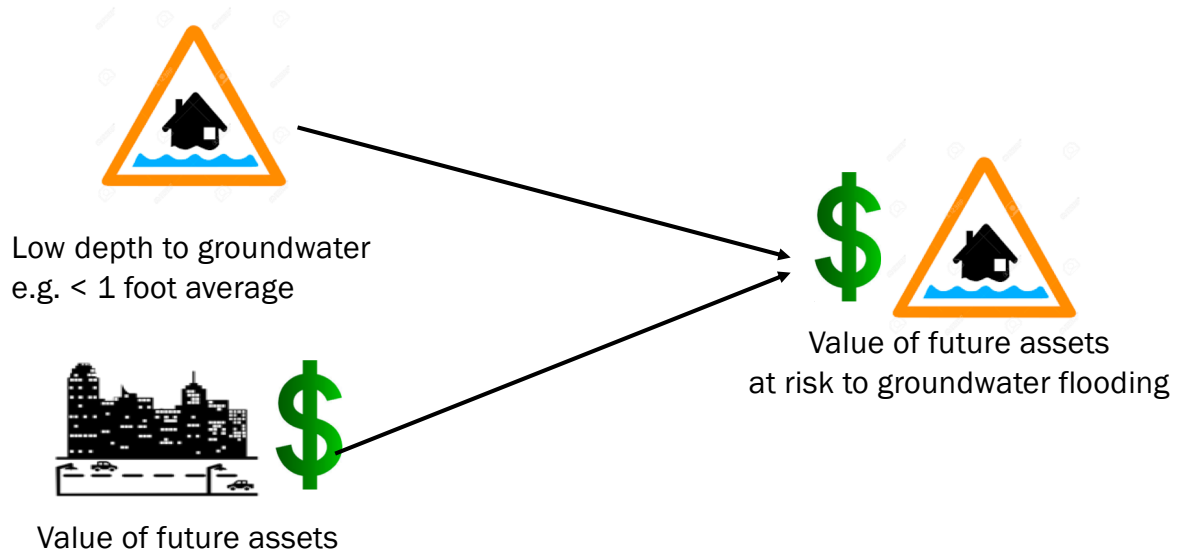
1. Random Method
  - Future assets distributed randomly on cells zoned for urban development
2. Elevation Method
  - Future assets preferentially distributed to high elevation cells zoned for urban development
3. Traffic Analysis Zone (TAZ)
  - Future assets preferentially distributed to traffic corridors



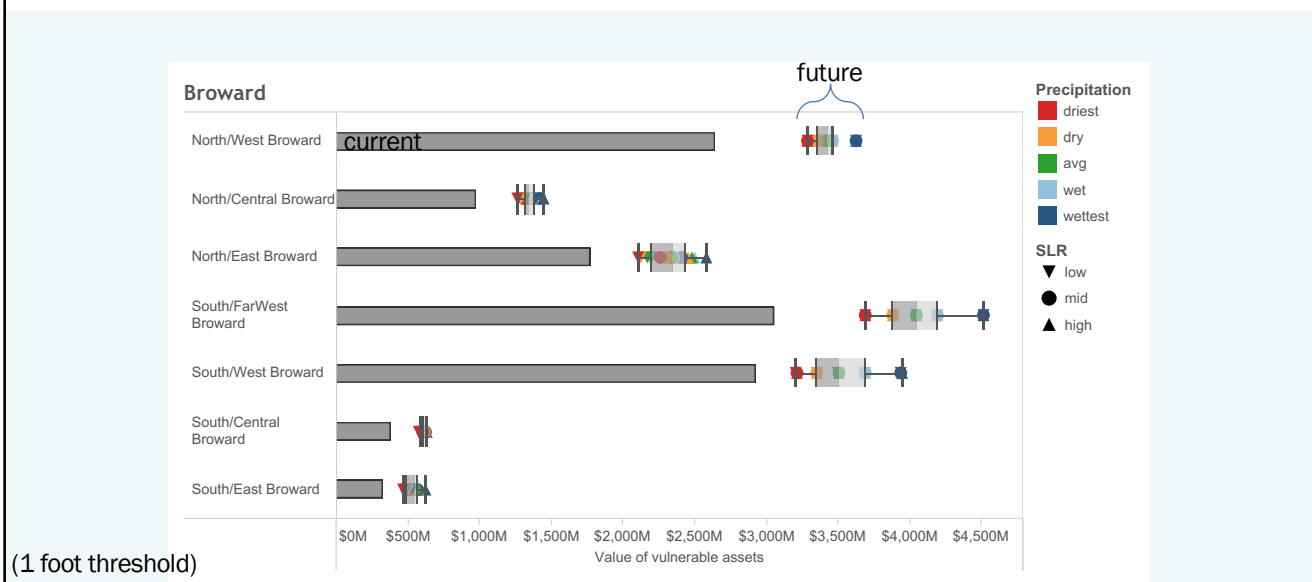
## Projection of future asset values for Broward county for three asset distribution methods (2015 – 2035)



## Vulnerability to groundwater flooding estimated by combining depth to groundwater and asset projections



## Summary of assets vulnerable to groundwater flooding in Broward County

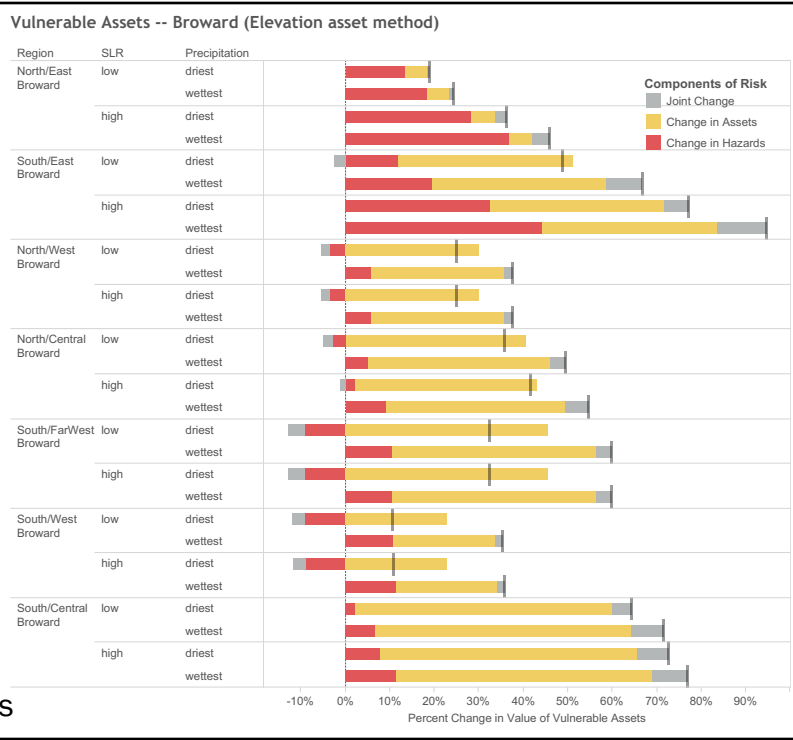


# Value of vulnerable assets in Broward for high SLR and wettest precipitation conditions



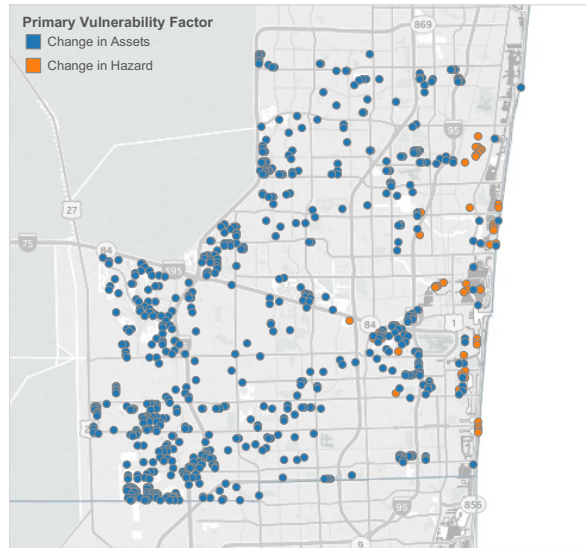
## Disaggregating groundwater flooding vulnerability identifies key drivers of vulnerability

Change due to hazard  
+  
Change due to assets  
+  
Change due to both  
=  
Total change in vulnerable assets



## Drivers of vulnerability to groundwater flooding for two futures for Broward

Low SLR / Driest Precipitation



## Adaptation Strategies— Reduce Exposure to Groundwater Flooding

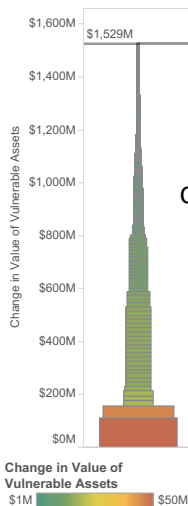
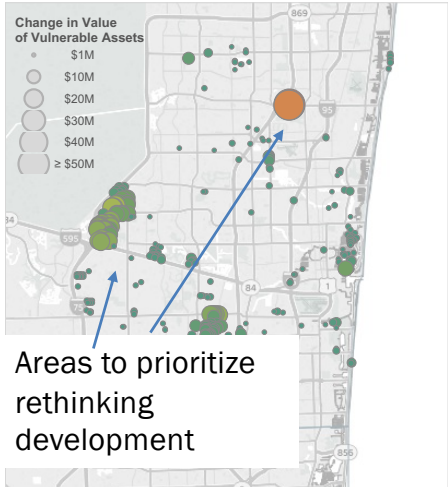
Type	
Status Quo	Implement 2040 Future Land Use Plan
Reduce asset growth high-hazard areas	(1) <b>Increase density at higher elevations:</b> above 5 feet
	(2) <b>Increase density along future transportation corridors:</b> Along 2035 Long-Range Transportation Projects
	(3) <b>Send and receive:</b> Reorient development away from high vulnerability areas
Reduce vulnerability of assets in high-hazard areas	(4) <b>Cut and fill:</b> Fill is used to raise existing development or increase elevation of new development
	(5) <b>Increased pumping and drainage</b>



## Regions of vulnerability increase for Broward for all but the wettest precipitation scenario

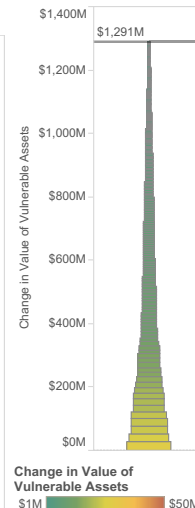
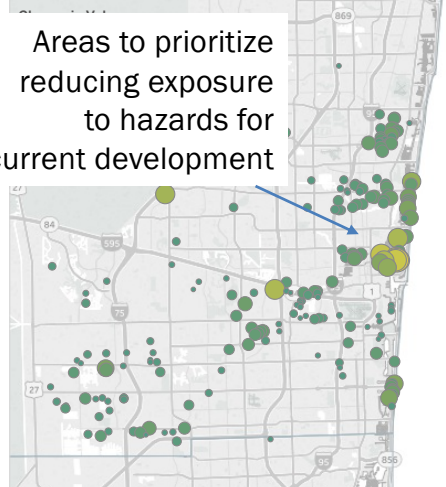
*Would changing development patterns help, and if so, where should we encourage or discourage development?*

### Asset Dominated Vulnerabilities



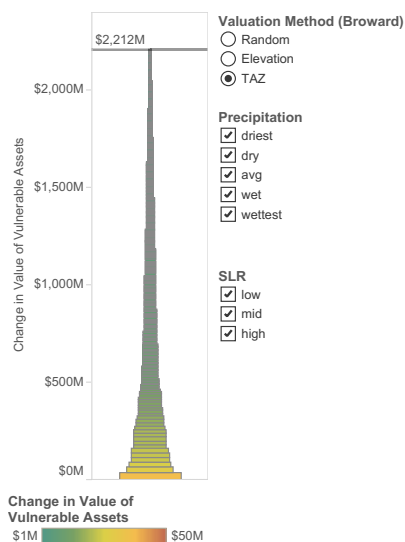
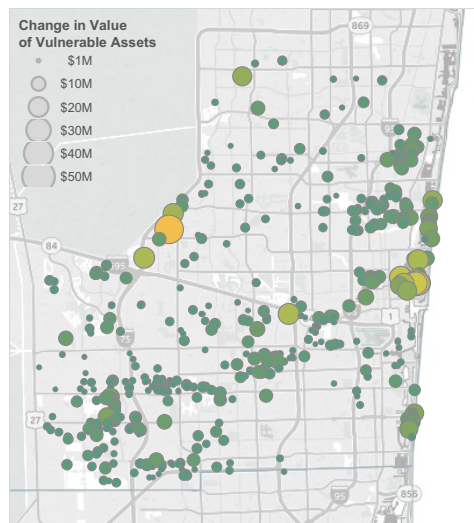
### Hazard Dominated Vulnerabilities

Areas to prioritize reducing exposure to hazards for current development

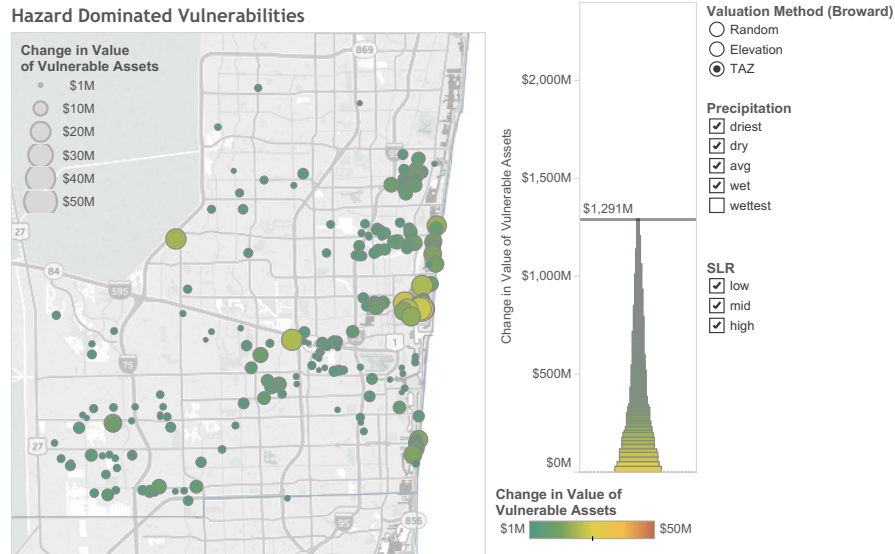


## Using the tool to see if a particular area is vulnerable and suitable for development

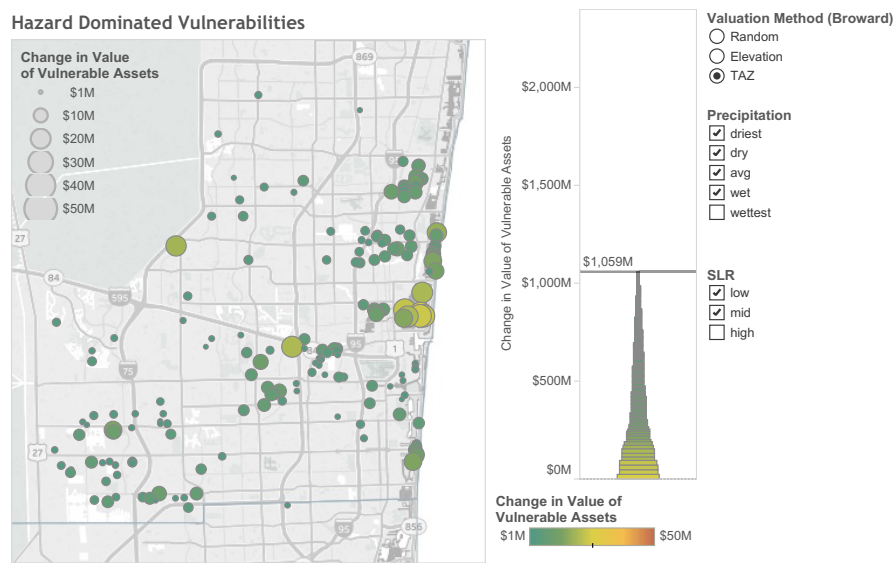
### Hazard Dominated Vulnerabilities



Using the tool to see if a particular area is vulnerable and suitable for development



Using the tool to see if a particular area is vulnerable and suitable for development



## Summary of results

(1 of 2)

- High level of current flood vulnerability across Broward
- Sea level rise will reduce depth to groundwater and increase vulnerability in coastal areas
- Changes in precipitation patterns could increase or decrease depth to groundwater broadly



Photo source: Reuters, presentation use only

## Summary of results

(2 of 2)

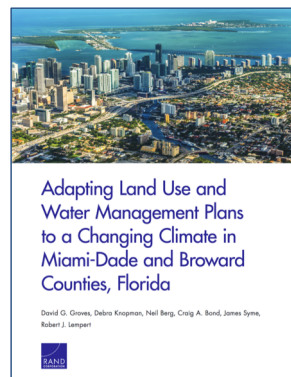
- Wide range in future vulnerable assets expected
  - *future development in currently impacted areas*
  - *increased hazards due to SLR and precipitation pattern changes*
- Focusing development near transportation projects could reduce risks broadly but concentrate in potentially vulnerable areas



Photo source: Reuters, presentation use only

# Discussion & Questions

Download the report from:  
[www.rand.org/pubs/research\\_reports/RR1932.html](http://www.rand.org/pubs/research_reports/RR1932.html)



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