Coastal Resilience Index

Synthesizing Hazard Vulnerability

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Motivations

Population Living on Coast

United States: 40%

Florida: 75%

Rate or Sea Level Rise

2011-2015: Sea Level Rise in Southeast Florida was >3 times the global average

- Valle-Levinson, A., Dutton, A., & Martin, J. B. (2017). ***Geophysical Research Letters*****.**

Inundation with a 6ft SLR

source: NOAA

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Motivations

Tidal Flooding: Temporary inunadtion of low lying areas during periods of exceptionally high tides

Florida: Estimated $5.4B in property value loss on account of tidal flooding

- First Street Foundation

Florida: Estimated $76B in costs for sea level rise adaptation by 2040

- Center for Climate Integrity

Getting the Risk Wrong Costs Money

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Defining Resilience

Vulnerability (V): function of risk factors that define loss potential at each location, i.

$$V_i = f(risk\ factors_i)$$

$$Resilience = \frac{1}{V}$$

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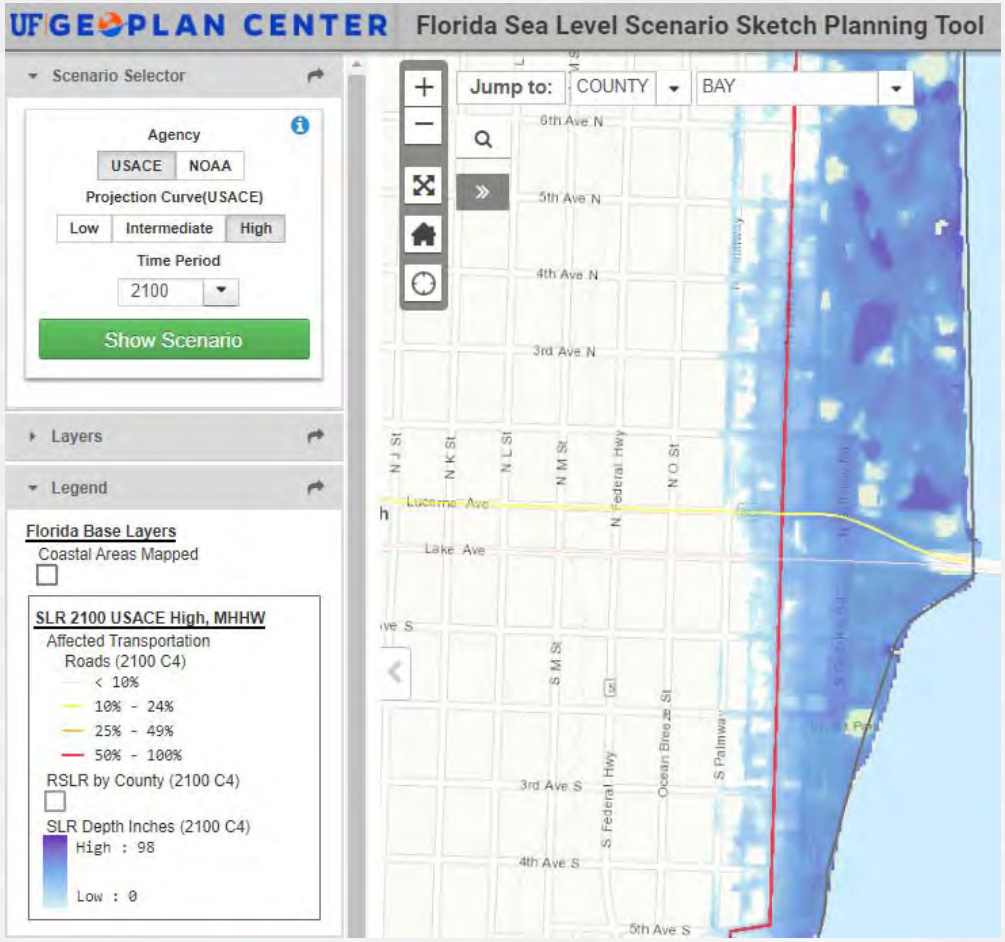
Existing Mitigation Analysis Tools

Sea Level Scenario Sketch Planning Tool (UF/FDOT)

Identifies and displays areas of potential inundation by sea level rise

Criteria

- Sea Leve Rise Flood Projections (USACE and NOAA)
- FDOT Roads layers
- Digital Elevation Models
- Google Base Maps



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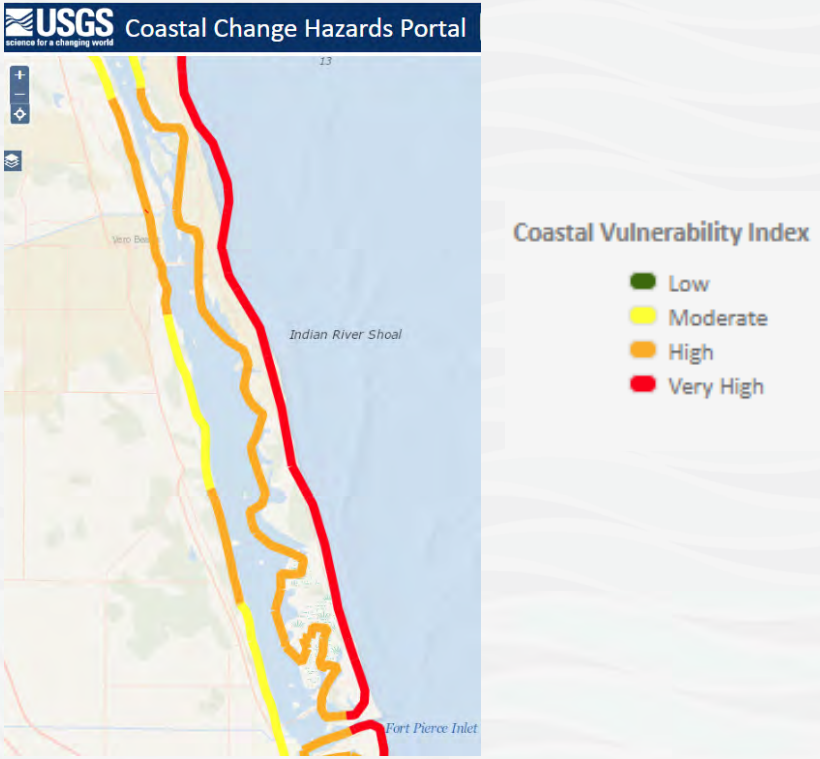
Existing Mitigation Analysis Tools

Coastal Vulnerability Index (USGS)

Indicates where physical changes are likely to occur due to Sea Level Rise

Criteria

- Tidal Range
- Wave Height
- Coastal Slope
- Shoreline Change



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Existing Mitigation Analysis Tools

HAZUS (FEMA)

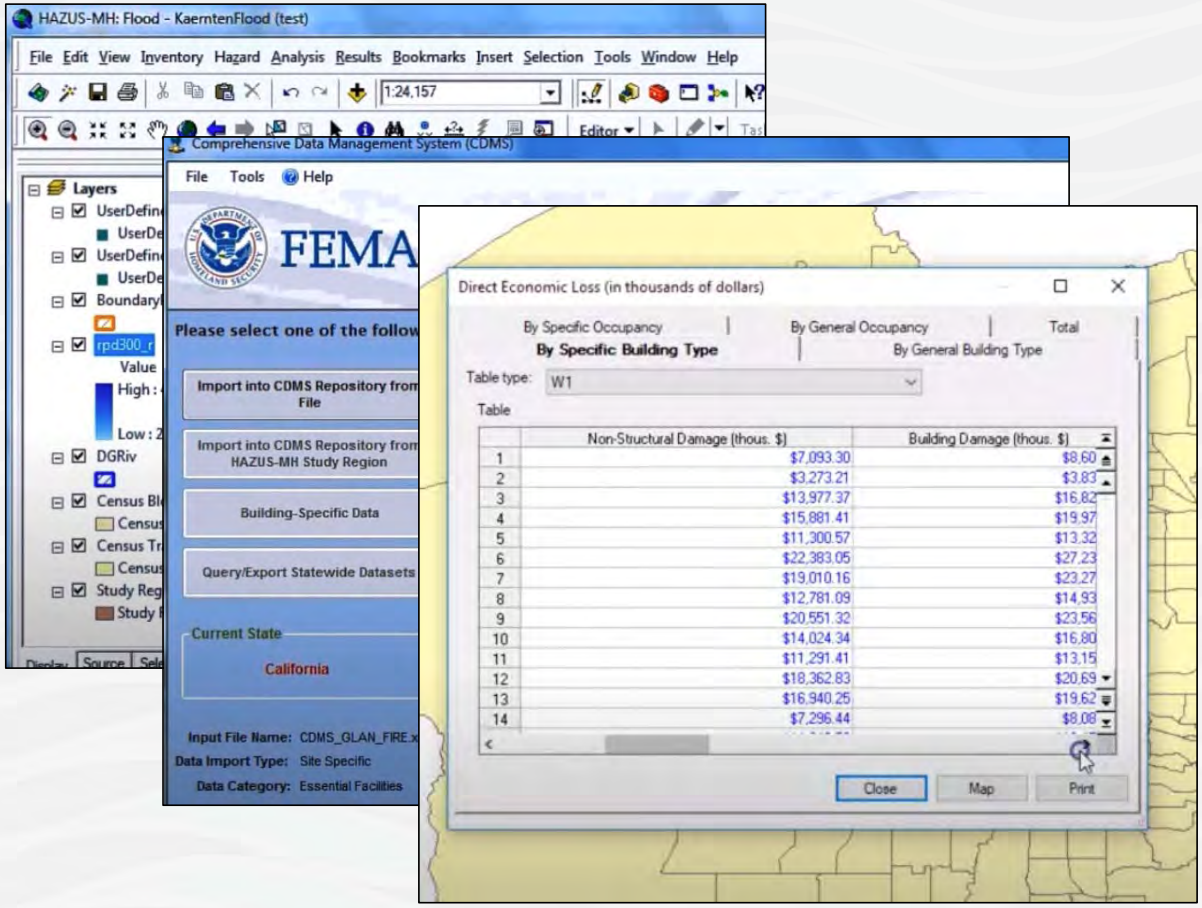
Calculates estimated loss due to physical damage from hazards

Spatially analyzes:

- Buildings
- Critical Facilities
- Infrastructure
- Debris Generation

Computes:

- Direct Loss
- Cost of Repair/Replace
- Income Loss
- Agricultural loss



Existing Mitigation Analysis Tools: Unsatisfied Needs

- ❑Ease of use
- ❑Holism
- ❑Florida-specific
- ❑Sea level rise
- ❑Climate change

Proposed Tool *Methodology: Multi-Linear Regression*

Objective: Establish statistical relationships to formulate vulnerability, defined as economic losses, based on past flooding events.

$$V = \beta_0 + \beta_1 P + \beta_2 F + \beta_3 C$$

V = Vulnerability [$]
P = Parcel Value [$]
F = Flood Zones [ft]
C = Census Count [.]

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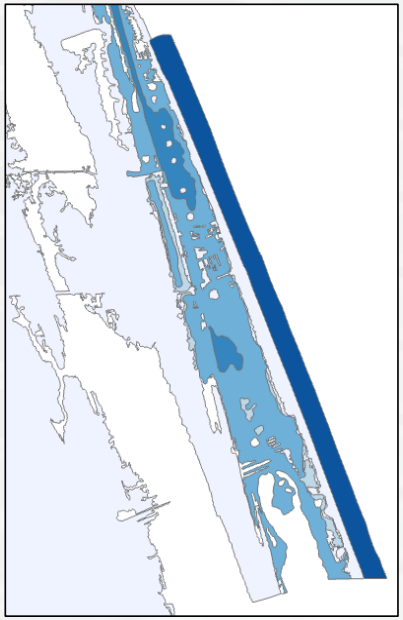
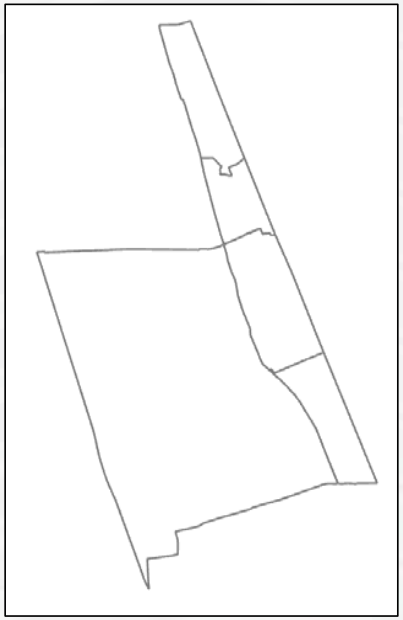
Conceptual Overview of a New Tool: *Inputs*

Parcels

Flood Zones



Census Blocks



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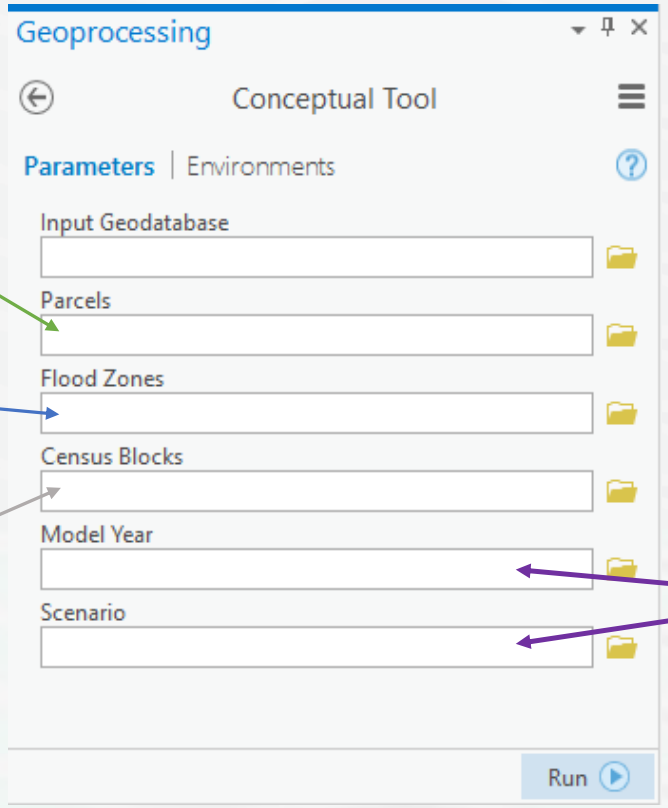
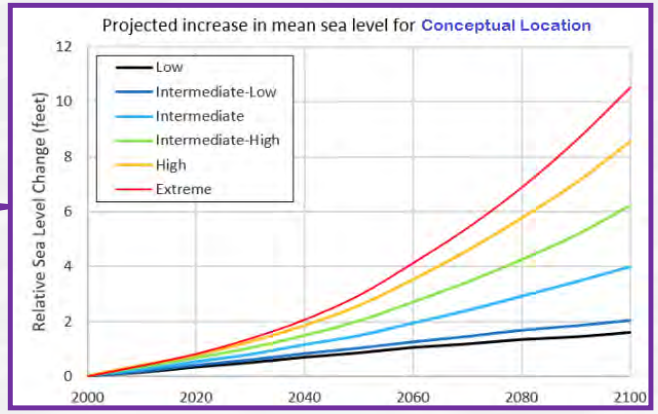
Conceptual Overview of a New Tool: *Interface*





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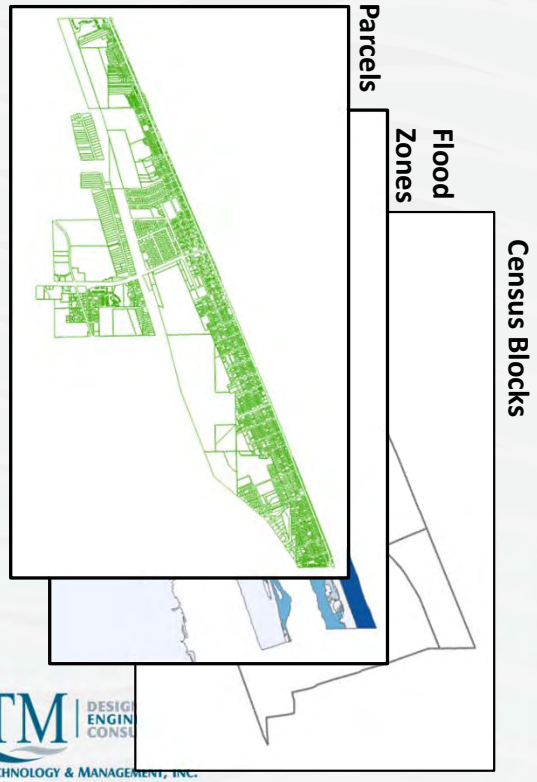
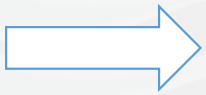
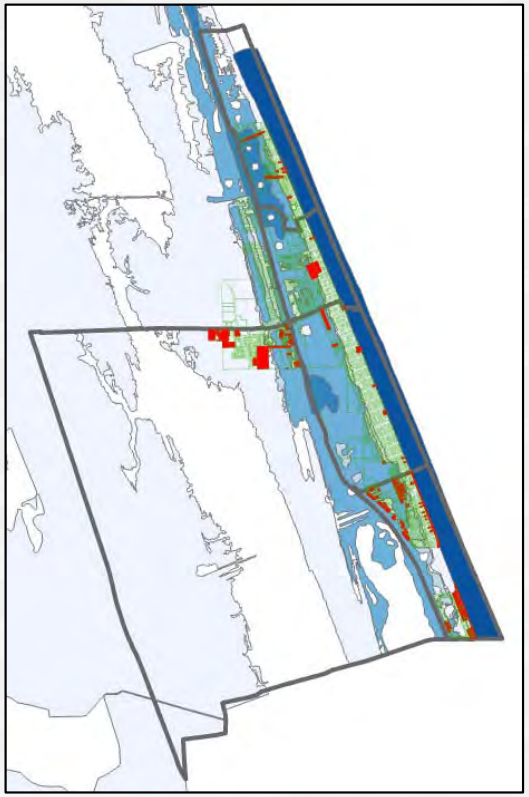
Conceptual Overview of a New Tool: *Output*







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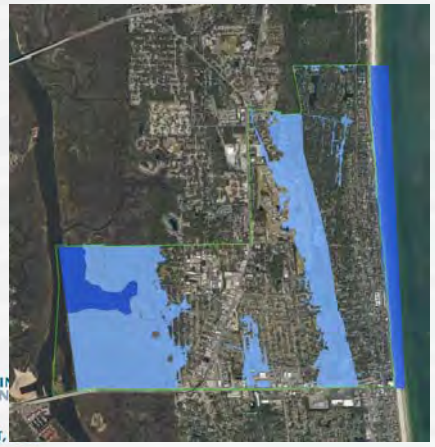
ATM's Tool:
Distinguishing Features

Florida-centered Modifications

- Coastal/Hydrodynamic Elements
- Insurance Factor

Sea Lever Rise and Climate Change

2044 Flooding



2069 Flooding

2119 Flooding

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ATM's Tool:
Increased Storm Frequency & Severity

GlobalChange.gov
U.S. Global Change Research Program

"The heaviest rainfall events have become heavier and more frequent"

FSA
Florida Stormwater Association

NOAA

"Tropical rainfall rates and intensities will likely increase in the future due to anthropogenic warming and accompanying increase in atmospheric moisture content"

Incorporating into tool:

- Gradually increase impact factor of flooding on a temporal scale

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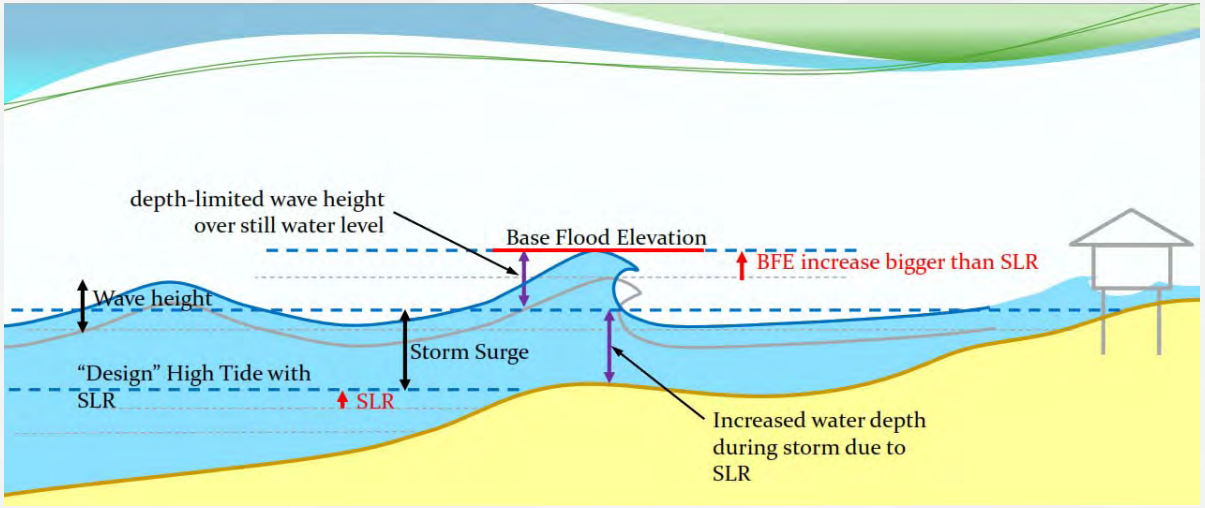
ATM's Tool:
Wave Height Adjustments



- FEMA flood maps do not account for Sea Level Rise
- Storm Surge and Wave Height for 100-yr storm may change if events are more intense or frequent

Incorporating into tool:

- Increase impact factor of VE Zones

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ATM's Tool:
Insurance Uncertainty

NAIC National Association of Insurance Commissioners

"a repeat of a Hurricane Andrew-sized loss today ($50 billion to $60 billion) would result in more insurer insolvencies than occurred in 1992."

"various vulnerabilities in the current Florida residential insurance market"

- Journal of Insurance Regulation (2018)

Incorporating into tool:

- Increase Parcel Value coefficient
- Increase impact factor of displaced household/residents

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Conclusions

How this Tool Helps FSA Members

- ❑ GIS-based
- ❑ Florida-centric
- ❑ Easy data acquisition
- ❑ Target identification without extensive resource outlay

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