Fundamental Objectives

- Facilitate two stakeholder engagement workshops each in three international sites providing new future hazard/climate impact information to partners:
  - Broward County, FL, USA (Hollywood & Dania Beach)
  - Santos, Brazil
  - Selsey, The United Kingdom
- Advance the understanding of connections between stakeholder values, beliefs, and preferences regarding risks, adaptation options and funding choices
- Understand barriers to adaptation
- Provide findings to inform regional stakeholders’ priorities for adaptation strategy
Project Objectives and Design

1. Solicit data from municipal staff and regional experts

2. Plan/facilitate community workshops (~6 weeks apart) to present COAST models, benefit/costs estimates and two adaptation options

3. Conduct survey of participants at beginning of Workshop One and after Workshop Two
   - Total attendees
     - Workshop One: 50
     - Workshop Two: 45
COAST Process Overview

• CoAST (Coastal Adaptation to Sea Level Rise Tool)
  • modeled flooding damage to assets (buildings) from storm surge and sea level rise and land lost to SLR
  • generated visualizations showing cumulative damage of flooding to buildings in study area through 2060 from expected 10, 50 and 100-year storms
  • estimated benefit/costs of two adaptation actions based on scope that workshop participants help define

• Two stakeholder engagement workshops in each site—vulnerability and no-action damages to real estate, “parameterization” of adaptation modeling, and discussion of B/C of avoided damages and costs of adaptation options
COAST Process
Modeling Step One:
Vulnerability Assessment

• if no action is taken

Jonathan “J.T.” Lockman AICP
Vice President
Catalysis Adaptation Partners
What the COAST Model Results Told Us at Meeting One:

How much building damage/land loss we might expect from:

● One-time future events (Wilma-sized storm surge);
● Cumulative damage over time, from many different sized storms; and
● How many land parcels could be lost to SLR over time

IF NO ACTION WAS TAKEN
SEA LEVEL RISE ASSUMPTIONS

- Annual Sea Level at Key West
- Projected Sea Level Rise Range based on USACE Guidance
- Historic Key West Sea Level Rise Rate for Comparison

2010 Sea level = 0
2030 3-7 inches
2060 9-24 inches
Surge Heights from all storms with Sea Level Rise

- For Cumulative Damages: Used surges from the 10, 50 and 100-year storms using 2014 FEMA Flood Study and Maps, and SLOSH models from other studies
- Then ADDED SEA LEVEL RISE to these surges OVER TIME
Example of Assessment Results: ONE-TIME DAMAGE
Wilma-sized Flood in 2060 with High SLR – Broward County Study Area

Total Storm Damage = $862.7M for entire study area, not just for extent pictured here.
- Removed from Asset Inventory Due to Permanent Inundation from Sea Level Rise (if no action taken)
- Building Damage from Storm Surge

For General Planning Purposes Only
COAST results: Estimates of Cumulative Damage

- from storm surge, for all storms and incorporating Sea Level Rise

Planning Period: 2015 - 2060

<table>
<thead>
<tr>
<th>SLR Scenario</th>
<th>Cumulative damage to buildings by scenario date for all storms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low – 9”</td>
<td>$ 3.3 billion</td>
</tr>
<tr>
<td>High – 24”</td>
<td>$ 5.3 billion</td>
</tr>
</tbody>
</table>

Note: All Storms = 1, 10, 50 & 100 year storm events; figures are in today’s dollars
## COAST results: Buildings and land lost to Sea Level Rise

**Planning Period: 2014 - 2060**

<table>
<thead>
<tr>
<th>SLR Scenario</th>
<th>Value of Buildings Lost to Sea Level Rise by Scenario Date</th>
<th>Value of Land Lost to Sea Level Rise by Scenario Date</th>
<th>No. of Parcels Lost to Sea Level Rise by Scenario Date</th>
<th>Total Value of Buildings and Land Lost to Sea Level Rise by Scenario Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low – 9”</td>
<td>$ 1.1 million</td>
<td>$ 312 million</td>
<td>53</td>
<td>$ 426 million</td>
</tr>
<tr>
<td>High – 24”</td>
<td>$ 2.5 million</td>
<td>$ 543 million</td>
<td>199</td>
<td>$ 791 million</td>
</tr>
</tbody>
</table>

Total Number of Study Area Parcels: 6,955

199 Parcels Lost by 2060 in High Scenario: 2.8% of Total Number

Value of 199 Parcels Lost by 2060: 8.4% of Total Assessed Value
At Meeting One, We Voted to Model Two Adaptation Actions

- Elevate and Floodproof; and
- Voluntarily Relocate Properties over time
We Modeled the Benefits and Costs of:
- Elevation in V-Zones (red)
- Floodproofing in A-Zones (green)

Action 1: Elevate and Floodproof
Action 1: Elevate and Floodproof

Properties in red in FEMA V Zone = Modeled as Elevated (87 total)
Properties in green in FEMA A Zone = Modeled as Floodproofed (2095 total)
We modeled a form of rolling easement where:

• Voluntary buyouts could be offered in two phases across Broward County
• Phase 1: for parcels expected to have high tide at their center by 2030 (red)
• Phase 2: for parcels expected to have high tide at their center by 2060 (green)

Note:
* For parcels in red – Cash payment today with title transferring in 2020
* For parcels in green – Cash payment in 2025 with title transferring in 2030
* Voluntary buyouts not offered for undeveloped land.

Action 2: Voluntarily Relocate Over Time

Parcels shown in red = lost to sea level rise 2010-2030.
Parcels in shown in green = lost to sea level rise 2030-2060.
Blue shade = High Tide in 2060 with 24” of sea level rise
Action 2: Voluntary Relocation with Rolling Easements

Modeled Voluntary Buyout of Properties shown in red = Lost by 2030 (44 total)
Modeled Voluntary Buyout of Properties in shown in green = Additional properties lost by 2060 (155 total)
Modeled New High Tide Shoreline in 2060 with High Sea Level Rise, shown in blue (24”)

## Costs and Benefits of Action

$ in billions, discount rate of 3.3%  

*with partial participation

<table>
<thead>
<tr>
<th></th>
<th>Floodproof and Elevate</th>
<th>Voluntary Buyouts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low SLR</td>
<td>High SLR</td>
</tr>
<tr>
<td>Damages with No Action</td>
<td>$1.677</td>
<td>$2.388</td>
</tr>
<tr>
<td>Damages with Action</td>
<td>$0.420*</td>
<td>$0.597*</td>
</tr>
<tr>
<td>Avoided Damages</td>
<td>$1.257*</td>
<td>$1.791*</td>
</tr>
<tr>
<td>Cost (Low Est.)</td>
<td>$0.057</td>
<td>$0.057</td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>Cost (High Est.)</td>
<td>$0.117</td>
<td>$0.117</td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td>11</td>
<td>15</td>
</tr>
</tbody>
</table>

Results from Fort Lauderdale, FL, 2015
What Do the Numbers Tell Us?

• Modeling shows elevating and floodproofing of buildings is cost effective!

• We modeled elevation and floodproofing to start immediately, but the modeled voluntary rolling easements were delayed, allowing owners to retain property for several years; this led to lower B/C ratios

• In a High Sea Level Rise Scenario, rolling easements allow properties to remain too long and they get damaged/inundated
Survey Research

Survey of Participant Values, Risk Experience, Adaptation Action & Funding Preferences (or Not)

Once **BEFORE** First COAST Workshop January 2015 -- Hollywood, FL

Again **AFTER** Final COAST Workshop March 2015 -- Dania Beach, FL
Survey Content

• Individual and community experience with coastal hazards

• Preferences for 16 potential adaptation actions at various timeframes (e.g., NOW, 10, 25, 100 years, or never)

• Preferences for existing and possible public finance mechanisms for adaptation

• Perceptions about barriers to implementation
People Responding at BOTH Workshops are “Panelists”

• Some attended and responded only at 1\textsuperscript{st} workshop

“Newbie” participants attended only 2\textsuperscript{nd} workshop
Highlights of Results:

1. Participant Characteristics
2. Adaptation Priorities From Menu & Modeled Actions
3. Funding Preferences
4. Perceived Barriers to Community Action
Workshop #1—Attendee Characteristics:

- 53% Male
- 87% White  11% African American  2% Hispanic
- 94% College Degree
- 48% 55 yrs of age or older  12% < 35 yrs of age
- 88% above median HH $$ income
- 52% Democrat  13% Republican  35% Independent

-- 43% local govt. staff  14% business owner  10% n’hood groups
   18% elected and appointed officials
“NEP” Values Index (New Ecological Paradigm)

Used in 100’s of studies in a dozen countries since 1979

WORKSHOP #1  3.8
WORKSHOP #2 “NEWBIES”  3.9
4.1 WORKSHOP #2 – PANELISTS

Nature To Be Commanded;
Nature Can Absorb Impacts

Nature Fragile; Human Impacts Need Control

Ranges:
ADAPTATION ACTIONS TESTED WITH PARTICIPANTS:
16 PLUS FINAL TWO ADAPTION ACTIONS MODELED

*************QUICK OVERVIEW (SEE HANDOUT) *************

CHOICES: Do NOW, 10 YRS, 25 YRS, 100 YRS, NEVER or UNSURE:
Collapsed to 3 categories here: NOW, 10 to 25 YEARS (SOON), or 100 YRS / NEVER / UNSURE

KEY PATTERNS:

1. Growth Mgmt. = top priority (stop new exposures)
2. Green and Natural Infrastructure also highest priority
3. Priority for ALL Gray Infrastructure actions ROSE, W1→W2
4. Mixed opinions about Structural Solutions & Property Buyouts
did NOT change much W1→W2
## FINAL TWO ADAPTATION ACTIONS MODELED

<table>
<thead>
<tr>
<th>Elevation &amp; Floodproofing as Modeled</th>
<th>Panelists</th>
<th>100 Yrs/ Never/ Unsure</th>
<th>New Attendees</th>
<th>100 Yrs/ Never/ Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOW</td>
<td>67%</td>
<td>33%</td>
<td>0%</td>
<td>60%</td>
</tr>
<tr>
<td>10-25 Yrs</td>
<td>42%</td>
<td>42%</td>
<td>16%</td>
<td>40%</td>
</tr>
<tr>
<td>Voluntary Buyouts As Modeled</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOW</td>
<td>42%</td>
<td>42%</td>
<td>16%</td>
<td>40%</td>
</tr>
<tr>
<td>10-25 Yrs</td>
<td>42%</td>
<td>42%</td>
<td>16%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Voluntary Buyouts: 42% (NOW), 42% (10-25 Yrs), 40% (100 Yrs/ Never/ Unsure)
VERY STABLE PREFERENCE ORDER FOR FUNDING ADAPTATION ACROSS WORKSHOPS & VALUES/POLITICS:

More Acceptable

Special Benefit/Assessment Districts
Low Interest Loans for Floodproofing
Bonding for Adaptation Needs (Mixed)
Property Tax-Based Adaptation Funds
Surcharge on Water Bills (Mixed)
Raise Sales Tax/Option Tax

Least Acceptable

“Rational Nexus” at Work!?

LOW NEP folks and Republicans scored acceptability lower
BUT basic ORDER same
Average ACCEPTABILITY Ratings: Funding for Adaptation

Somewhat: WaterBillCharge, RaiseSalesTax, PropertyTaxFund, BONDS

Moderately: WaterBillCharge, PropertyTaxFund, BONDS, RaiseSalesTax

Highly: SpecialBenDistrict, LowInterestLOANS

Totally: SpecialBenDistrict, LowInterestLOANS, consistent winners

Panelists: BLUE

Workshop 1 (Final) ratings: RED
<table>
<thead>
<tr>
<th>Perception</th>
<th>Before Workshops</th>
<th>After Final Workshop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denial: My property won’t be impacted</td>
<td>25%</td>
<td>58%</td>
</tr>
<tr>
<td>Opposed to new taxes, fees to</td>
<td>50%</td>
<td>67%</td>
</tr>
<tr>
<td>Lack of knowledge of future consequences</td>
<td>42%</td>
<td>83%</td>
</tr>
<tr>
<td>Climate change distant issue</td>
<td>67%</td>
<td>17%</td>
</tr>
<tr>
<td>Local Govt. lack expertise to act</td>
<td>17%</td>
<td>8%</td>
</tr>
</tbody>
</table>

NOT ISSUES: scientific uncertainty, distrust of media, concern over tourist economy, real estate economy
Qualitative Case Study Design and Findings: Barriers to Adaptation

• Data Sources
  • Field notes
  • 10 in-depth interviews, post-workshops

• Research Questions
  • What are stakeholders’ values re: responding to coastal vulnerabilities?
  • What opportunities/barriers do stakeholders deliberate about re: the COAST models?

• Findings: Barriers
  • lack of leadership
  • invisibility of the (longer-term) problem
  • consistent funding needed
  • comprehensive models
Qualitative Case Study Findings: Values and Preferences for Adaptation Action

• “place” and a commitment to making the region more resilient

• “Safety and access” defined in terms of:

  • concern about damage caused by high winds and flooding to individual/community property

  • location of critical infrastructure and vulnerability/age of transportation infrastructure
Possible Take-Aways

• Giving stakeholders better information is a positive (what we planners always wish to believe) IF people can “own” the analysis process.

• The COAST approach provides a framework for discussion of adaptation that focuses on action and benefits – not just on future damage and “climate politics”.

• Data used in Broward County for COAST can be found throughout Florida coastal communities with similar vulnerabilities.

• **Infrastructure** is a key area where public understanding and support for action can be increased with better information—people respond to the need for future access, resiliency, safety.
Thanks to:

NSF Award #1342969

Florida Partners:

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