Achieving Buy-In for Adaptation

E2 Tech Forum
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USM Wishcamper Center

Helping Communities and Stakeholders Decide on Economically Viable Sea Level and Storm Surge Adaptation Strategies with the COAST software tool

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In the Spring of 2012, Dr. Sam Merrill, Director of the New England EFC at the Muskie School, created Catalysis Adaptation Partners, to spread the use of the Coast Approach beyond Maine and New England.

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http://www.catalysisadaptation.com
What is “COAST?”

COAstal Adaptation to Sea level rise Tool
The COAST approach and software tool were developed at the Muskie School of Public Service.

University of Southern Maine
Portland, Maine
USM is part of the Environmental Finance Center Network

The EFCN is a university-based organization creating innovative solutions to managing costs of environmental protection and improvement. It consists of ten EFCs serving states in EPA's ten regions. By sharing information, tools and techniques, the EFCs help address difficult how-to-pay issues of providing environmental services.

Why did we name the company “Catalysis?”

The word *catalysis* comes from chemistry. To catalyze means to create a reaction by bringing things together; we are experts in catalyzing local adaptation to sea level rise and storm surge, by bringing together innovative technology with tailored community engagement processes.
Some Project Sites, Completed or Underway

- East Machias/Falmouth, Maine
- Old Orchard Beach, Maine
- Portland, Maine
- Hampton/ Hampton Falls/Seabrook, New Hampshire
- Cambridge, Massachusetts
- Logan Airport/Massport, Boston, Massachusetts
- Duxbury/Marshfield/Scituate, Massachusetts
- Groton/Mystic, Connecticut
- Kingston, New York
- Oxford, Maryland
Steps in the COAST Process

1. Engage Stakeholders to Select Different Scenarios for Sea Level Rise and Storm Surge.
Portland Tide gauge = global ocean over last century (1.8 mm/yr, IPCC (2007)).
In Maine, this is the fastest in past 3000 years

1.86 mm per yr or 0.61 ft (7.3") per century

Use Local Data – Connect with Peoples’ Experiences
2. Provide a Vulnerability Assessment with Cumulative Expected Damage Estimates Over Time for a “No Action” Scenario of Sea Level Rise and Storm Surge
Example: Hudson River, Kingston, NY
Select an Asset to Model: Damage to Real Estate
You Need Accurate Elevation Data: LiDAR
To Predict Future Damage to Real Estate You Need a Tax Parcel Map with Assessed Values
Then you need a "Depth-Damage Function"...

Depth-Damage Function for Single Family Residential Structures with Basement

<table>
<thead>
<tr>
<th>Depth</th>
<th>Mean of Damage</th>
<th>Standard Deviation of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>-8</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>-7</td>
<td>0.7%</td>
<td>1.34</td>
</tr>
<tr>
<td>-6</td>
<td>0.8%</td>
<td>1.06</td>
</tr>
<tr>
<td>-5</td>
<td>2.4%</td>
<td>0.94</td>
</tr>
<tr>
<td>-4</td>
<td>5.2%</td>
<td>0.91</td>
</tr>
<tr>
<td>-3</td>
<td>9.0%</td>
<td>0.88</td>
</tr>
<tr>
<td>-2</td>
<td>13.8%</td>
<td>0.85</td>
</tr>
<tr>
<td>-1</td>
<td>19.4%</td>
<td>0.83</td>
</tr>
<tr>
<td>0</td>
<td>25.5%</td>
<td>0.85</td>
</tr>
<tr>
<td>1</td>
<td>32.0%</td>
<td>0.96</td>
</tr>
<tr>
<td>2</td>
<td>38.7%</td>
<td>1.14</td>
</tr>
<tr>
<td>3</td>
<td>45.5%</td>
<td>1.37</td>
</tr>
<tr>
<td>4</td>
<td>52.2%</td>
<td>1.63</td>
</tr>
<tr>
<td>5</td>
<td>58.6%</td>
<td>1.89</td>
</tr>
<tr>
<td>6</td>
<td>64.5%</td>
<td>2.14</td>
</tr>
</tbody>
</table>
Then you need to input predicted flood heights from the 10 year, 25 year, 50 year, 100 year, and 500 year storms, from your FEMA flood insurance study or whatever you’ve got...
Projection of Sea Level Rise from 1990 to 2100


Then you need to input the scenarios of sea level rise you believe will be added to the storm floods over time...
The model will then tell you the amount of dollar damage predicted for a particular-sized storm in a particular year...

And it will calculate the cumulative expected damage, summed up from all of the predicted storms from today until that particular year.
## COAST Model for City of Kingston - Modeled Water Levels and Vulnerability Assessment Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Sea Level Rise Scenario</th>
<th>Storm Intensity (return period in years)</th>
<th>Predicted Elevation of Flood Height from FEMA Flood Insurance Study, 2007 NAVD88 (ft.)</th>
<th>COAST Model of Sea Level Rise Above Mean Higher High Water (MHHW) in 2013 Selected by Kingston (in./ft)</th>
<th>COAST Model Total Flood Elevation for Each Scenario NAVD 88 (ft.)</th>
<th>COAST Model Expected Damage to the Value of All Buildings &amp; Improvements From This Single Storm Incident in the Scenario Year ($ Million)</th>
<th>COAST Model Expected Damage to the Value of Waste Water Treatment Plant Only From This Single Storm Incident in the Scenario Year ($ Million)</th>
<th>COAST Model Cumulative Expected Damage to the Value of All Buildings &amp; Improvements From All Storms, 2013 to Scenario Year ($ Million)</th>
<th>COAST Model Percent of Cumulative Expected Damage to the Value of All Buildings &amp; Improvements Attributable to Sea Level Rise Only (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1 No SLR</td>
<td>10 yr</td>
<td>6.0</td>
<td>0</td>
<td>0</td>
<td>6.0</td>
<td>12.0</td>
<td>8.7</td>
<td>n/a</td>
</tr>
<tr>
<td>2013</td>
<td>2 No SLR</td>
<td>100 yr</td>
<td>8.2</td>
<td>0</td>
<td>0</td>
<td>8.2</td>
<td>21.7</td>
<td>16.8</td>
<td>n/a</td>
</tr>
<tr>
<td>2060</td>
<td>3 Lo SLR</td>
<td>10 yr</td>
<td>6.0</td>
<td>20</td>
<td>1.67</td>
<td>7.7</td>
<td>18.8</td>
<td>14.4</td>
<td>69.0</td>
</tr>
<tr>
<td>2060</td>
<td>4 Lo SLR</td>
<td>100 yr</td>
<td>8.2</td>
<td>20</td>
<td>1.67</td>
<td>9.9</td>
<td>24.7</td>
<td>18.8</td>
<td>69.0</td>
</tr>
<tr>
<td>2060</td>
<td>5 Hi SLR</td>
<td>10 yr</td>
<td>6.0</td>
<td>36</td>
<td>3</td>
<td>9.0</td>
<td>22.0</td>
<td>16.8</td>
<td>73.5</td>
</tr>
<tr>
<td>2060</td>
<td>6 Hi SLR</td>
<td>100 yr</td>
<td>8.2</td>
<td>36</td>
<td>3</td>
<td>11.2</td>
<td>29.5</td>
<td>22.2</td>
<td>73.5</td>
</tr>
<tr>
<td>2100</td>
<td>7 Lo SLR</td>
<td>10 yr</td>
<td>6.0</td>
<td>33</td>
<td>2.75</td>
<td>8.8</td>
<td>21.9</td>
<td>16.8</td>
<td>82.7</td>
</tr>
<tr>
<td>2100</td>
<td>8 Lo SLR</td>
<td>100 yr</td>
<td>8.2</td>
<td>33</td>
<td>2.75</td>
<td>11.0</td>
<td>27.5</td>
<td>20.6</td>
<td>82.7</td>
</tr>
<tr>
<td>2100</td>
<td>9 Hi SLR</td>
<td>10 yr</td>
<td>6.0</td>
<td>68</td>
<td>5.67</td>
<td>11.7</td>
<td>29.7</td>
<td>22.2</td>
<td>88.3</td>
</tr>
<tr>
<td>2100</td>
<td>10 Hi SLR</td>
<td>100 yr</td>
<td>8.2</td>
<td>68</td>
<td>5.67</td>
<td>13.9</td>
<td>34.5</td>
<td>24.8</td>
<td>88.3</td>
</tr>
</tbody>
</table>

1. Tidal state is included in FEMA FIS predicted flood elevations for the 10 year and 100 year storms.
2. Elevation of Mean Higher High Water (MHHW) in year 2013 is 3.0 feet (NAVD 88).
3. Discount Rate of 3.3 percent applied.

Date Run: 03-03-2013
A Close-up Look at the COAST Model Output...

Scenario 6:
Year 2060, 100-yr Storm, Hi SLR, Height = 11.2 ft (NAVD 88)
West Strand Street/Rondout Landing Area

COAST Output

- Relative Height of Blue Boxes Indicates Predicted Dollar Damages to Buildings and Improvements from Total Flood Height
- Relative Height of Red Boxes Indicates Predicted Dollar Damages from Sea Level Rise Only
Scenario 6: Year 2060, 100-yr Storm, Hi SLR, Height = 11.2 ft NAVD 88
Scenario 6: Year 2060, 100-yr Storm, Hi SLR, Height = 11.2 ft NAVD 88

Depth 2.2 ft.
Damage $158 K

JAF Partners Inc. @1 Broadway
Damage to Assets Other than Real Estate Can be Modeled:

- Economic output
- Public health impacts
- Displaced persons, vulnerable demographics
- Natural resources values
- Cultural resources values
- Community impacts
- Infrastructure (transportation, energy, facilities, telecommunications)
Next Steps in the COAST Process

3. Select Candidate Adaptation Actions to Protect from Sea Level Rise and Storm Surge, Staged Over Time, and Estimate the Costs of Each Action

4. Perform a Cost Benefit Analysis of Adaptation Strategies
Example: Groton/Mystic, Connecticut
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level rise, normal tides</td>
<td></td>
<td>No action up to minimal flood proofing and infrastructure elevation along river.</td>
<td>Insignificant</td>
<td>Insignificant</td>
</tr>
<tr>
<td>A</td>
<td>3.2 – 4.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>5.5 – 6.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-year storm event in 2010</td>
<td></td>
<td>Hurricane Barrier at Mystic River entrance.</td>
<td>$18 Million</td>
<td>$75,000</td>
</tr>
<tr>
<td>C</td>
<td>5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>7.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-year storm in 2070, Hi SLR</td>
<td></td>
<td>Hurricane Barrier at Mystic River entrance.</td>
<td>$27-30 Million</td>
<td>$100,000</td>
</tr>
<tr>
<td>E</td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>8.9</td>
<td><strong>ADDITIONAL FORTIFICATION and elevating the railroad, as well as increased diking to east.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-year storm in 2070, Hi SLR</td>
<td></td>
<td>Hurricane Barrier at Mystic River entrance.</td>
<td>$35 Million</td>
<td>$120,000</td>
</tr>
<tr>
<td>G</td>
<td>8.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>10.5</td>
<td><strong>FURTHER FORTIFICATION and elevating the railroad, as well as increased diking to east.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Last Step in the COAST Process

5. Start Doing Something! Implement the Strategies, and Move the Needle off of Zero.