Climate Change Adaptation for Coastal Infrastructure – Assessing and Managing Risks
Making Effective Use of Uncertain Information

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November 13, 2009

Small Sea Changes: Big Infrastructure Impacts
Houston
Outline

- Challenges and barriers to adaptation in coastal infrastructure
- Framework to streamline adaptation
- Efforts underway on adaptation and infrastructure
- Summary
Challenges and Barriers

- Diverse decision makers with diverse capacity and information needs
- Perception of uncertainty is a hurdle
- Screening, assessing, and managing climate risks is complicated and resource-intensive
  - Developing planning-relevant climate change scenarios is a significant hurdle
  - Emphasis on long time-frames requires projecting not only climate, but also other long-term drivers difficult to foresee
  - Few damage functions or guidelines are available
  - Engineered structures often specify design standards in terms of intensity-duration-frequency targets (e.g., 100-year flood), and climate “stationarity is dead” (Milly et al. 2008)
  - Many climate risks have “low probability/ high consequence” characteristics
  - Little info is available on cost-effectiveness of adaptation options
  - Little info is available on costs of inaction
- The benefits of adaptation are largely unproven
Challenges and Barriers

- In a world of limited resources, adaptation looks scary, time-consuming, and of questionable value

*How can we streamline adaptation in coastal infrastructure design, planning, asset management, and operation/maintenance?*
Prioritize where to focus efforts to adapt to climate change in the near term.
Risk Screening: Where Does Climate Have a Role?

- How sensitive is the asset/system to climate change?
  - Is climate a factor now?
  - Will changes in average climate—or in the “tails”—be a factor?
- What is at stake if a wrong decision is made?
  - Impacts/damages of climate potentially high?
  - Damages irreversible or difficult to reverse?
  - Is the asset/system critical?
  - Is capital investment large?
  - Can negative effects of climate be ameliorated by possible adaptive action?
- Timing and time horizon: is there a need to take immediate action?
  - Is there an immediate threat based on current conditions?
  - Are decisions being made now that will govern actions for sometime to come, or do decisions take time to be implemented?
Risk Screen: Output

- **Group 1**: climate change is not a key stressor

- **Group 2**: climate change could become important, but options remain open to adapt in the future – monitor and revisit periodically

- **Group 3**: assess risks and start managing them now
  - Climate change risks are significant relative to other stressors
  - Planning and implementation life-cycles are long, or plans are difficult to adjust once in place
  - Resource value or project costs are high
  - Institutional resources are available to manage risk

*Even without detailed climate projections, asset/system managers can use the screen to determine whether detailed climate change risk assessment and management (e.g., engineering analysis) is warranted*
Examples of Potential Candidates for Adaptation Planning in the Short-term

- **High-cost, long-lived infrastructure programs**
  - Energy generation and transmission infrastructure
  - Transportation system design
  - Wastewater treatment and drinking water treatment design and siting
  - Flood control programs

- **Long-term programs with high cost of failure/ difficult to reverse decision**
  - Land use planning/ zoning
  - Transportation plans

- **High-value programs with high cost of failure**
  - Emergency management and communication plans
  - Insurance programs
Framework for Streamlining Adaptation

1 - Risk Screening
Prioritize where to focus efforts to adapt to climate change in the near term

2 - Risk Assessment
Assess the impacts of stressors to inform management decisions

3 - Risk Management
Risk Assessment Tools

- Climate effect scenarios (e.g., DOT climate effects typology)
  - Sea level rise (inundation, storm surge)
  - Temp (mean and extremes)
  - Precip (mean and extremes)
  - Flows (mean and extremes)

- Damage functions (translating effects to impacts)
  - Endpoints
  - Functional form
  - Effect/damage relationship – probability and consequence
  - Use existing frameworks to extent possible (e.g., NIPP)
Framework for Streamlining Adaptation

1 - Risk Screening
Prioritize where to focus efforts to adapt to climate change in the near term

2 - Risk Assessment
Assess the impacts of stressors to inform management decisions

3 - Risk Management
Take action to reduce impacts or exploit beneficial opportunities
Risk Management Tools

- Lists of options
  - By type of damage
  - Conditions for suitability

Florida Community Water Systems: Vulnerability and Value Rating
Risk Management Tools

- Cost models
  - First order cost estimates

- Effectiveness models
  - How much do the options reduce climate risk?
  - To what extent are there co-benefits?
  - What is the cost of inaction?

- Methods to characterize uncertainty
  - Key sources
  - Comparison to “familiar” sources of uncertainty
## Current Efforts on Adaptation and Infrastructure

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<thead>
<tr>
<th>Initiative</th>
<th>Improving Risk Assessment Methods</th>
<th>Risk Management Assistance to Decision Makers</th>
<th>Communication/Outreach</th>
<th>Resources for Adaptation</th>
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Summary

- Climate change adaptation is relevant to some – but not all – coastal infrastructure planning and design
  - A risk screening process can help identify high priorities for detailed risk assessment and management
- For infrastructure, detailed assessment and management of climate-related risks is complex and involves considerable uncertainty …
  - … which makes it just like analyzing risks from many other, more familiar stressors
  - … which benefit from the availability of frameworks and info and familiarity with them
- Efforts are underway to provide frameworks and info
- If a climate bill is enacted, state and local governments could have significant resources to address adaptation which would provide an impetus for improving climate risk assessment and management
- As the US embarks on the biggest wave of investment in 70 years, we need to ensure that 21st century infrastructure is not designed for 20th century climate
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