Coastal Adaptation Working Group

ADAPTATION IN COASTAL SYSTEMS: RECONCILING UNCERTAINTY WITH COMPLEX SOCIO-ECOLOGICAL SYSTEMS

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NRC 2009: Decisions & Climate Change

- “We’re Not Ready”:
  - Governmental agencies, private institutions and individuals are “conceptually and practically unprepared” to either address the challenges or to capitalize on the opportunities presented by uncertain events.
- “Stationarity is Dead” (Milly et al., Science 2008):
  - Application of past climate information (and their associated probabilities of extreme events) are no longer valid for the design and implementation of infrastructure or societal policies such as zoning and transport.
- Climate change will create a “novel and dynamic decision environment”
  - A situation which demands a fundamentally different decision regime than the current, historically-focused methods.

Current Methods of Dealing with Uncertainty

- Beat it into submission: Command & Control
- Assume it away: out of sight, out of mind.
- Seek “spurious certitude” (Gunderson, 1999)
  - “...to break a problem down into trivial questions spawning answers and policy actions that are unambiguously “correct”, but, in the end, are either irrelevant or pathologic”

Definitions & Concepts

- Vulnerability as a function of exposure & sensitivity
- Adaptive capacity (Smit and Wandel, 2006)
  - social network stability, infrastructure robustness, ecological resilience
  - determinants being both local and regional
- Maladaptation actions that may give short term benefits to one group at the expense of larger society or other groups over the longer term
Climate Risk Drivers for Coastal Areas

<table>
<thead>
<tr>
<th>Climate Change Impacts</th>
<th>Interacting Factors</th>
<th>Climate</th>
<th>Non-Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sea Level Rise</strong></td>
<td>Inundation</td>
<td>Elevated Extreme Water Levels</td>
<td>Wave/storm climate, erosion, sediment supply</td>
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<tr>
<td></td>
<td></td>
<td>Backwater from rivers</td>
<td>Run-off</td>
</tr>
<tr>
<td><strong>Morphological Change</strong></td>
<td>Wetland loss (and change)</td>
<td>CO2 fertilisation of biomass production, sediment supply and migration space</td>
<td>Sediment supply, migration space, land reclamation (i.e., direct destruction)</td>
</tr>
<tr>
<td></td>
<td>Erosion (of beaches and soft cliffs)</td>
<td>Sediment supply, wave/storm climate</td>
<td>Sediment supply</td>
</tr>
<tr>
<td><strong>Hydrological change</strong></td>
<td>Saltwater intrusion (surface and groundwater)</td>
<td>Run-off/rainfall</td>
<td>Catchment/aquifer management (over-use), land-use</td>
</tr>
<tr>
<td></td>
<td>Rising water tables/impeded drainage</td>
<td>Run-off/rainfall</td>
<td>Land-use, aquifer use, catchment management</td>
</tr>
<tr>
<td><strong>Changes in storminess</strong></td>
<td>Inundation (as above)</td>
<td>Wind: Damage to buildings and infrastructure</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rainfall: Local flooding</td>
<td>Run-off</td>
</tr>
</tbody>
</table>

Table 1: Climate change-related drivers of risk in coastal regions (adapted from Parry et al. 2009).

Significant social assets are exposed

- Climate change & subsidence
- Socio-economic change
- Today

Adaptation: Options, Costs & Tools

- Planned adaptation events
  - Managing exposure
  - Accommodation
  - Protection
- Adaptation as a Decision Making Process
- Tools: Moving beyond *Mainstreaming*
  - Adaptive management
  - Evolutionary approaches
  - Identifying *critical transitions* (tipping points...) (Scheffer, 2009)

Thames 2100 Case Study

- Adequacy and options surrounding the Thames Barrier
- A large flood barrier that protects London from North Sea storm surges.
  - Built in response to the 1953 surge disaster
  - Designed to provide at least 1-in-1000 year standard of protection out to 2030.
  - Opened in 1984;
- Given this long lead-time experienced for planning and building (31 years), the Thames 2100 project was instigated in 2000.
Thames 2100 Case Study: Pathway Options to allow adaptation

Maximum sea level rise:

- 0m
- 1m
- 2m
- 3m
- 4m

Options:

- Improve defences
- Over-rotate Thames Barrier and restore interim defences
- Flood storage, improve Thames Barrier, raise u/s & d/s defences
- New Barrier, retain Thames Barrier, raise defences
- New barrier, raise defences
- New barrage with locks / Barrage

The High Level Options

Note:
Each box represents one or more portfolios of responses.
The arrows indicate paths for adapting options for different sea level ranges.

New Thoughts:
Climate Change as a “Black Swan” Problem
(Taleb, 2007)

- The event is surprising (at least, to the observer).
- The event has major impacts.
- After the fact, the event is rationalized by hindsight, as if it had been expected.
BP Oil Spill Response and the Changing Climate Future: a flock of Black Swans?

- Who is in charge?
- What can/should be done before or after an event?
- The role of government/business?
- Adaptation? Restoration? Retribution?

Discussion for Working Group

- The “Best Possible Science” myth?
  - Embrace uncertainty and look evasive...
  - Ignore uncertainty and look incompetent when things change...
- Integration with socio-cultural issues is preliminary at best...
- Policy Paradoxes (Cortner & Moote, 1999)
  - expert and open decision making
  - Flexibility vs consistency
- Most coastal challenges are replete with uncertainties...
- The path forward
  - create favorable conditions for decision support and risk analysis tools
  - aid planners and participants in developing technically accurate and functionally efficient adaptation policies.