Impact assessments and decision-making: How can we connect the two?¹

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Do assessments make any difference in decision-making anyway?

Despite extensive ongoing international and (US) national efforts to assess the significance of sea-level rise and climatic changes, there is still rather scant concern with these problems among US coastal zone policy-makers and managers, especially at sub-national levels (Moser 1997, 1998). The level of concern and knowledge about global climate change and sea-level rise, not to speak of actual policies or implementation of any such policies are highly uneven across US coastal zone managers. To date, only one US state (Maine) explicitly mentions accelerated SLR as justification for a coastal legislative change and actually uses SLR projections as a base for its regulations. A good number of other states has undertaken studies of the potential impacts of SLR on their coastlines or has policies that could be adapted in dealing with sea-level rise. Few, like North Carolina, require that SLR be considered in land use plans, but have no regulatory “teeth” behind such requirements or any other concerted approaches to deal with this long-term threat. Interview evidence suggest that the vast majority of state and even local coastal zone managers is familiar with sea-level rise, but has no plan or policies in place to take it into account in short- or long-term decision-making.

Does this mean that assessments really make no difference to those decision-makers? Do the assessment results even reach sub-national decision-makers? And if they do, why have they done so little in changing the policy- and decision-making landscape along the coast? If in fact it is true that “there is ... a grave mismatch between the knowledge that is needed to act locally and what is currently being done globally to generate knowledge about climate change, its impacts, and responses to concerns” (Wilbanks and Kates 1998) then the question arises how the plethora of scientific global change information can be made more useful or whether new types of information are needed by those at regional and local levels of scale who ultimately will have to decide on and implement pragmatic responses to a changing environment.

Prior research indicates that highly functional, two-way information exchanges across various levels of scale (international to local) is a necessary if not sufficient condition for a greater integration of global change science into decision-making at national and sub-national levels (Moser 1997). This integration of information and decision systems needs to be coupled such that relevant and credible information flows to practitioners with real decision-making powers. In addition, a significant and maybe more focused effort than made so far is necessary to create a demand for global change-related information. This information needs to connect with present management problems at different scales and involve a broad range of agencies, interest groups, and legislative actors (Moser 1998).

Isn’t it time we changed the way we think about assessments?

Traditionally, assessments have been thought of as syntheses and critical appraisals of scientific information on a particular topic. They usually involve models and analyses, result in a report, and are considered complete when they are delivered to whoever asked for the assessment. Recent research in the Global Environmental Assessment Project, conducted at Harvard University, has developed a broader conceptualization. Assessments encompass the outcomes (the reports, the models and analyses) and the social, dynamic, iterative processes that lead to and follow them -- the communicative, social interactions among assessors and scientists, and those among scientists, interested groups, and potential assessment users like policy-makers or managers. As such, they can serve a variety of functions (Miller, Jasanoff et al. 1997):
• integrating disparate knowledge from many different disciplines and research programs into consensus answers;
• disseminating this consensus to, i.e., informing and educating the policy-and decision-maker community;
• identifying gaps in scientific understanding;
• reevaluating the relevance of knowledge claims;
• affecting the nature of the communities that produce scientific knowledge and that use it to inform public opinion and decision-making; and
• providing the resources and opportunities for (new) groups to interact and develop common ground with respect to policy choices.

Embedded within these broader social functions of assessments are additional strategic functions of assessments (or any information perceived as authoritative) as rhetorical devices, symbols, or means for political legitimization or obfuscation and so on. Thus, if the goal is to design environmental assessments that can affect decision-making at lower levels of scale, there are at least three venues for this cross-scale influence of assessments to manifest itself: (1) to design the assessment process in such a way that it actively involves actors from different levels of scale; (2) through efforts made to disseminate assessment results from a higher level of scale to lower levels of scale; or (3) when local assessment initiatives attract the attention of higher levels of scale, stimulate larger assessment processes and eventually become integrated into the larger assessment efforts undertaken by supra-local actors.

Impact analysis (the focus of this workshop) might thus better be thought of as part of a much larger assessment process that involves a great variety of agents. Figure 1 which depicts the assessment process in a two-dimensional space between scale and the different roles of assessment participants may serve as a heuristic to identify relevant players.

Can the gulf between scientists and decision-makers be bridged?

The range of actors involved in an assessment process – neatly organized by scale and role in Figure 1 – fall, of course, rarely in such clear categories. Sometimes the boundaries between the categories along the science-policy continuum are rather blurry. Other times, it is necessary to draw strict boundaries between them, for example, to safeguard legitimacy and credibility. While the nodes in Figure 1 depict placeholders or roles, real people connect also outside easily identifiable organizational structures (e.g., in networks or coalitions) which do not always match with particular spatial scales. Moreover, different agents are situated at, and act from, particular locales, but their respective research interests, concerns, resources, information services, technical capacities, and decision-making authorities vary considerably in reach. This variance actually allows for cross-scale relationships to emerge via a myriad of possible connections, but it implies also that many interactions are too complex to neatly fall into scale categories (e.g., the local, regional, state, national, or global scale).

This complexity of interactions is one of the reasons why “scale” best be understood only as a useful starting point for understanding the structures, relationships, and myriad connections that constitute information and decision systems (Moser 1998). Frequently, scale is not the only or even primary boundary that separates actors in a formally and informally established system to support the exchange of information and decision-making. Other boundaries often exist between science and policy (or more generally, knowledge and action), between disciplines, interests represented by different groups, between values and belief systems, between cultures, industries, organizations or institutions, classes, and in the international arena, also between countries and...
their legal systems. In other words, scale boundaries are one type within a larger set of boundaries.

Social and cultural factors shape our perception and definition (or framing) of the problems we may assess. They also shape the roles actors inhabit in an assessment process. These factors affect where we draw the boundaries between issues, levels of scale, roles, and so on (Jasanoff 1987). Most of us (scientists) can easily imagine these boundaries by recalling the common experience of finding a gulf (made up of differences in interests, languages, ways of thinking, approaches to problems, institutional cultures and so on) separating us from the world of policy- and decision-makers.

The answer then to the question whether we can bridge this gulf between science and decision-making begins with the recognition, understanding, and respect for the function of boundaries. Even socially constructed boundaries can be very real. They are, however, not inherently negative. They can both impede the assessment process and cross-boundary communication and interaction, and they can organize interactions in orderly manners by clarifying authority relationships.

A second part to the answer lies in making conscious efforts to build on useful boundaries, to bridge them where they appear as hurdles, and to build so-called boundary organizations or boundary spanners into the assessment process. Boundary organizations are institutions that perform information translation or information brokerage functions; they do some of the leg work of connecting between information providers and information users; and they can serve as mediators in situations where there is little trust and credibility. By virtue of being the link, they also allow the institutions or people on either side of the boundary to continue functioning in the way they are used to function best without having to compromise their identity. Finally, boundary organizations are accountable to both sides in delivering certain services.

A third part of the answer to how we can bridge the gulf between science and decision-making is related to the second. If information needs to be conveyed more effectively to decision-makers, the usual summaries of analyses, assessment reports, and scientific publications in the established outlets will not do. Interview evidence suggests that practitioners do not have the time (or job description) to keep up with the scientific literature (Moser 1998). Scientific publications are what we have always done; they are the “easy” answer; and they are for us what establishes credibility (via peer review). But they are insufficient to reach the audience we ultimately want to inform. Recent impact analyses have become better at capturing policy changes (adaptations, responses to climate change). Some of these responses will happen spontaneously or habitually; others need to be orchestrated, organized, educated about, lobbied for, and won’t come about without more effective conveyance of relevant knowledge to those who will implement them.

Effective cross-boundary communication needs to use established networks of communication and collaboration which span the scientific and decision-making worlds. If scientists choose to partake in them directly, they will have to establish their credibility in them. This takes time and an open attitude toward the customs and perspectives of the decision-making world. In my recent research (Moser 1998) and as of yet unpublished Heinz Center work I found that a humble attitude of listening first and offering services second goes a long way toward building trustful relationships. Telling decision-makers what to do, and acting as if we know what matters to them, what needs they have, and what pressures they work under, will predictably meet with resistance. We are experts entering expert territory.
From sea-level rise impact models to real coastal management decision problems

What are some of the issues then that need translating and bridging in order for impact models to better connect with what real decision-makers in real places are faced with on a daily basis? The following facts and findings contextualize the sea-level rise problem in US coastal management reality:

- US coastal zone management occurs under a diverse set of legislation, carried out under the auspices of multiple federal, state, and local agencies. Their charge, goals, interests, compatibility, and the coordination among them is far from smooth and far from producing a coherent approach to coastal management.
- The Coastal Zone Management Act, enacted more than 25 years ago, is the primary piece of legislation framing US coastal management. Only through amendments in later reauthorizations did sea-level rise and coastal hazards enter the act as relevant pressures on coastal resources. The CZMA does not require states to address SLR.
- Coastal zone management laws vary considerably from state to state in the degree and manner in which they address short-term and long-term coastal hazards (see Figure 2). In addition, local jurisdictions vary in the stringency with which state or local regulations on shoreline development, shoreline protection, or beach management are implemented. Frequently, there is a good deal of freedom (sometimes confusion) in interpretation of these rules in “emergency situations,” i.e., cases where properties are imminently threatened by inundation, erosion, or coastal storm-related hazards. One might argue that with continuing/accelerating SLR, all future situations will become emergency situations.
- (Historical) Sea-level rise is a happening fact (along the majority of the US coastline) and all coasts experience climate and sea-level variability (see Figure 3). What we are seeing now then is how we adapt to sea-level rise and climate variability. This is not to say that we will not develop additional or more stringent measures in the future.
- Interview evidence suggests, however, that what we are seeing now is not conscious adapting to sea-level rise. Rather, shoreline management is a compromise of sorts between ongoing development trends, the political and economic realities, pressures, and attitudes that come with them, and the tangible threats of living in a desirable, but highly dynamic and rather unpredictable environment.
- Humans – much like the metaphorical frog that stays in water which is slowly brought to a boil – have an enormous capacity not only to adapt to changes in the environment, but to tolerate slowly unfolding undesirable environmental changes. Rapid undesirable environmental changes, like coastal disasters, are much less acceptable, and the natural human impulse seems to be to restore normal, pre-disaster conditions. Much empirical research and experience with emergency and post-disaster management indicates that these are only in the most exceptional cases the times when disaster-struck communities are interested, willing or available to implement long-term disaster reduction measures. Much of the SLR adaptation literature, however, presumes precisely those times as windows of opportunity to implement retreat policies and other adaptation measures.

What do these findings imply for SLR impact modeling? Several aspects require rethinking. First, impact assessors think very differently from decision-makers, an observation not meant to pigeon-hole any single individual, but to appreciate the difference in problem formulation and problem solving. Using a maybe simplistic caricature, an assessor tends to ask, “How can I make my model better capture the natural and societal processes operating now and in the future?” This contrasts with the thinking of the potential user of an assessment: “Is there anything in it that might help me make the decision on this permit application today (given the regulatory, resource,
staff time, and political constraints that I’m working under)?” A successful answer to one helps little in solving the other one’s challenge and vice versa.

The second implications follows from the first. There is currently no direct translation between the SLR impact analysis and the daily reality of the policy- or decision-maker. Global SLR scenarios, cumulative data on wetland losses, national declines in GNP generated by coastal economies that are dependent on healthy beaches – all these serve at best as supplementary arguments in legislative findings, or to justify more research or to request additional program funds. They do not affect daily decision-making (Moser 1998). The translation between models and decision-making requires a re-framing of the problem that assessors and decision-makers deal with, taking into account the scale and the phenomenon as it is perceived. In other words, SLR-impact models have to become erosion-impact models, property-loss models, tax revenue-loss models, beach nourishment-cost models, shoreline-hardening models, wetland-loss models. Short of that, there need to be algorithms or intermediary models that connect SLR impacts and response options with the actual decision problems as they present themselves to governmental and private decision-makers.

**Science to the test: Will decision-makers accept your science?**

How can this translation be accomplished? The answer suggested here brings us back to the notion of assessments as social, iterative communication processes. It may require to involve decision-makers in the assessment process during various phases, like the design, goal setting, and interpretation stages, and probably intermittently to keep them “in the loop” (i.e., to sustain their interest). This involvement may begin by asking what kind of information decision-makers need in their daily decisions, in what form it is most useful and relevant, and – importantly -- what makes it credible. The current political climate in US coastal decision-making places an extraordinarily big emphasis on liability. Decision-makers are liable for providing wrong information and for not providing information that could have saved money or lives. Information thus must be credible and, if necessary, defensible in boards of appeals or even in court.

The next step may involve asking what additional data would be useful and could be brought to bear on present decision-making, given the rules and regulations that guide or constrain it. There are a number of existing policies (setbacks, no-hardening rules, land use plans, etc.; see Figure 2) which states and municipalities can already use to address some SLR-impacts. Simple lack of data is one of the reasons that constrains their implementation today. Thus, a useful approach might be to create linkages between model results and the data sets used at present. For example, if decision-makers need average erosion (shoreline retreat) rates to calculate setbacks, use local models of shoreline retreat to translate SLR into retreat. In addition, use known variabilities in climate extremes (storm frequency) to calculate fluctuations in shoreline position (which may be a more useful indicator for a setbacks on relatively stable shorelines), to project flooding damages, house losses, land losses, beach losses, or increases in permit applications for shoreline hardening structures.

Changing policies that would explicitly put in place new rules to deal with SLR, however, is both time- and labor-intensive, very difficult given current political interests, but maybe also increasingly likely in the future as traditional policies are recognized as insufficient. At the very least, new policies will meet greater resistance.
In the end: will they believe you and your uncertain science?

Decision-makers are more likely to react to credible information with local applicability than to global information, however compelling. They will react to tangible (visible or imaginable) changes, and all the more strongly, if presented in a visually appealing and understandable manner. GIS platforms have proven highly effective in helping this visualization of possible future changes (as apparent from several case studies on community response to coastal erosion).

Global change information has to pass several tests – and not just once, but repeatedly, before its receiver lends it credibility or even acts on it. When information holds politically charged implications (e.g., when it suggests limits on the safety of certain shoreline areas for development), decision-makers may only feel safe using it with the added “protection” of scientific peer review. The more contentious and uncertain a problem is, the greater is the need for, and the power of the credibility tool of science. Information about uncertain phenomena that in their abstract, global conceptualizations go beyond (most) people’s daily experience also needs to stand the test of common sense (“the last time I checked, water expands when you warm it up, so with global warming, there goes your sea level...”) and the test of time (predictions of impacts coming true). Information also needs to pass the test of origin and cross-check: my interviews often revealed a bias toward information produced by local experts. At the same time, this information gained in credibility and impact if confirmed by independent outsiders (another form of peer review with a geographic slant). Finally, even if information passed all these tests, its credibility would still be contentious if it came from someone the potential receiver or user did not trust. To build trustful relationships with scientists, non-scientists frequently want scientists to emerge from their ivory towers and be more accessible to help people understand scientific (and frequently uncertain) information. Perceived aloofness or “hiding” behind allegedly solid science affects people’s willingness to receive and struggle with scientific information (Moser 1998).

Science, after all, is not the daily bread of most people. If we’re honest, we tend to forget that. It takes some really compelling reason (usually some form of feeling affected) to think, or even do something, about things complex and uncertain. This is not to say that lay people – private or official – don’t deal with uncertain, complex things. They do all the time, but not always consciously and often reluctantly. Differently put: challenges to one’s worldview are quickly checked for flaws that would allow one to drop them. Changes in ways of thinking – for good reason – don’t come easily. It takes sustained effort to shift them. This has direct implications for the communication effort necessary to affect coastal policy choices, and for SLR impact models which probably need to build in more human resistance (time lags) into their decision algorithms.

Finally, I suggest that we entertain the possibility that increases in the reliability and certainty of climate science and impact modeling may not necessarily lead to more effective decision-making at all, even if all the ideas presented above are taken to heart. Why? Because there are non-scientific human-dimension uncertainties that may matter just as much or even more in determining whether scientific information is actually used in decision-making (Moser 1997). People differ in how they expect the world to work, how they value scientific knowledge, in their attitudes toward uncertainty and ignorance, and in their valuation of impacted systems. In addition, there are uncertainties in how SLR signals are perceived, how people define the problem, who the involved actors are, what policy-making and management institutions are involved, which policy choices and strategies are available, feasible, chosen and implemented, and what external events and trends may foster or impede SLR adaptation. This is to say, the cognitive/scientific uncertainties in climate and SLR science make up only a small portion of what is relatively unknown. To the extent that the human-dimension uncertainties can be captured
in impact analysis (which would make them into social-scientific uncertainties), the models will become all the more realistic. Even if that could be accomplished, an exclusive focus on only those uncertainties conducive to modeling, will certainly underdetermine SLR impacts. Moreover, such a narrow focus may be distracting from the non-quantifiable human-dimension uncertainties which could be tackled outside the science lab -- even in the absence of scientific “certainty.
References


International Affairs, John F. Kennedy School of Government, Harvard University.


Research reports drawn on for this paper


Figures

Figure 1 Assessment pathway heuristic

The bi-directional arrows indicate stylized pathways of communication and interaction among different actors in an assessment process. The two-dimensional template can also be used to map assessments to visualize the degree of cross-scale and science-policy integration. Two hypothetical pathways (black arrows and white arrows) are illustrated above. Participants in the workshop produced a wide range of different pathways based on actual assessment experiences.

(Note: This heuristic is based on work by S. Moser, birthed by W.C. Clark and further developed in a 1998 GEA summer institute in Bar Harbor, ME (see the GEA website, footnote 1, for more information).)
### Figure 2

Sea level rise-relevant rules & regulations in selected states: Maine, North Carolina, South Carolina & Hawai’i

<table>
<thead>
<tr>
<th>Rules &amp; Measures</th>
<th>MAINE</th>
<th>NORTH CAROLINA</th>
<th>SOUTH CAROLINA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulated Areas</strong></td>
<td>all areas in sand dune system potentially affected by a 3-foot rise in sea level</td>
<td>9 types of “Areas of Environmental Concern”</td>
<td>only beachfront areas</td>
</tr>
<tr>
<td><strong>Setback rules</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Baseline</strong></td>
<td>YES current mean SL</td>
<td>YES first line of stable vegetation</td>
<td>YES first line of stable vegetation</td>
</tr>
<tr>
<td><strong>Baserate</strong></td>
<td>none</td>
<td>average long-term erosion rate; updated every 5 yrs</td>
<td>average long-term erosion rate; updated every 8-10 yrs</td>
</tr>
<tr>
<td><strong>Setback line</strong> (from baseline)</td>
<td>inland reach of 3 feet of SLR over the next 100 years</td>
<td>ERx30 for structures up to 2500 sq.ft</td>
<td>ERx40 for all structures</td>
</tr>
<tr>
<td><strong>Minimum setback</strong></td>
<td>behind V-flood zone or frontal dune</td>
<td>60 feet</td>
<td>behind frontal dune</td>
</tr>
<tr>
<td><strong>Retreat Policy</strong></td>
<td>Damage beyond repair is set at 50%; structures that are rebuilt have to meet setback regulations</td>
<td>No explicit rule</td>
<td>Damage beyond repair is set at staggered %-ages: until 6/1995 80% 6/1995-2005 66% &gt;2005 50% structures that are rebuilt have to meet setback regulations</td>
</tr>
<tr>
<td><strong>Erosion Control</strong></td>
<td>no new hardening of dune systems; repair and maintenance of hard structures allowed (incl. enlargement of seawall base); bulkheading only if no negative impacts; beach nourishment</td>
<td>strict no-hardening rule; only temporary relief through sand bags for imminently threatened structures once per lot; repair of hard structures allowed; beach nourish-ment; bulkheading allowed</td>
<td>no new hardening of sandy or estuarine shoreline unless no harm to adjacent areas can be proven; repair of hard structures allowed; beach nourishment encouraged</td>
</tr>
<tr>
<td><strong>Land-Use Planning</strong></td>
<td>YES (through separate law), but only weak implementation</td>
<td>YES, but no implementation requirements; SLR needs to be addressed in</td>
<td>NO; note that the state has a comprehensive planning act, but it is not at all mandatory</td>
</tr>
<tr>
<td>Rules &amp; Measures</td>
<td>MAINE</td>
<td>NORTH CAROLINA</td>
<td>SOUTH CAROLINA</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>requirements; no mention of SLR</td>
<td>plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>limited in the 250-foot shoreland zone; size, height restrictions in area potentially affected by 3 feet SLR</td>
<td>placement of growth-inducing public facilities in hazard areas restricted; no mobile homes in hazard areas</td>
<td>discouraged in setback areas by not allowing hard erosion controls</td>
</tr>
</tbody>
</table>

### Figure 3

**Time Scale, Magnitude, and Predictability of Sea-Level Variability Associated with Specific Phenomena**

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Time scale</th>
<th>Magnitude</th>
<th>Predictability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming</td>
<td>50-&gt;100 years</td>
<td>2-10 mm/year</td>
<td>unpredictable</td>
</tr>
<tr>
<td>Interdecadal oscillation</td>
<td>10-20 years</td>
<td>10-40 cm</td>
<td>unpredictable</td>
</tr>
<tr>
<td>El Niño</td>
<td>4-5 years</td>
<td>30-60 cm</td>
<td>6-9 months lead</td>
</tr>
<tr>
<td>Annual Cycle</td>
<td>1 year</td>
<td>10-40 cm</td>
<td>predictable</td>
</tr>
<tr>
<td>Intraseasonal osc.</td>
<td>40-60 days</td>
<td>10-20 cm</td>
<td>15-30 days lead</td>
</tr>
<tr>
<td>Fortnightly tide</td>
<td>14 days</td>
<td>4-5 cm</td>
<td>predictable</td>
</tr>
<tr>
<td>Synoptic weather</td>
<td>3-7 days</td>
<td>10-30 cm</td>
<td>0-10 days lead</td>
</tr>
<tr>
<td>Tides</td>
<td>½-1 day</td>
<td>1-3 m</td>
<td>predictable</td>
</tr>
<tr>
<td>Storm surges</td>
<td>5 hours</td>
<td>2-4 m</td>
<td>0-2 hours lead</td>
</tr>
<tr>
<td>Wave group setup</td>
<td>20 minutes</td>
<td>1 m</td>
<td>10 minutes lead</td>
</tr>
<tr>
<td>individual waves</td>
<td>15-25 seconds</td>
<td>2-15 m</td>
<td>unpredictable</td>
</tr>
</tbody>
</table>

**ENDNOTES**

1 For further information on the project, workshop reports, working papers, and fellowship information, see http://www.environment.harvard.edu/gea/.

2 For writings on networks and coalitions see (Heclo 1978; Sabatier 1988; Marsh and Rhodes 1992; Rhodes and Marsh 1992; Glasbergen 1993; Sabatier 1993; Sabatier and Jenkins-Smith 1993; Stevenson and Gilly 1993; Bressers, Huijtema et al. 1994; Campbell 1994; Bressers, O'Toole et al. 1995; Cigler and Loomis 1995; Masters 1995; Skocpol and Campbell 1995; Masters 1997; Rhodes 1997; Curtis and de Lacy 1998).

3 Some pertinent writings on boundary organizations and boundary spanning include (Aldrich and Herker 1977; Leifer and Delbecq 1978; Fennell and Alexander 1987; Ancona and Caldwell 1990; Ancona and Caldwell 1992; Guston forthcoming).

4 For example, certain areas in Charleston flood not just during storm event, but during regular high tides because of the changed baseline of the ocean. In other coastal towns in South Carolina I have seen this tolerance manifest in street signs that warn of high tide flooding and of the corrosive nature of salt water.