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Talk Globally, Walk Locally:
The Cross-Scale Influence of Global Change Information on Coastal Zone Management in Maine and Hawai'i

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CITATION, CONTEXT, AND REPRODUCTION

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The Global Environmental Assessment (GEA) project is a collaborative team study of global environmental assessment as a link between science and policy. The Team is based at Harvard University. The project has two principal objectives. The first is to develop a more realistic and synoptic model of the actual relationships among science, assessment, and management in social responses to global change, and to use that model to understand, critique, and improve current practice of assessment as a bridge between science and policy making. The second is to elucidate a strategy of adaptive assessment and policy for global environmental problems, along with the methods and institutions to implement such a strategy in the real world.

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Publication abstracts of the GEA Project can be found on the GEA Web Page at http://environment.harvard.edu/gea. Further information on the Global Environmental Assessment project can be obtained from the Project Associate Director, Nancy Dickson, Belfer Center for Science and International Affairs, Kennedy School of Government, Harvard University, 79 JFK Street, Cambridge, MA 02138, telephone (617) 496-9469, telefax (617) 495-8963, Email nancy_dickson@harvard.edu.

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FOREWORD

This paper was written as part of the Global Environmental Assessment Project, a collaborative, interdisciplinary effort to explore how assessment activities can better link scientific understanding with effective action on issues arising in the context of global environmental change. The Project seeks to understand the special problems, challenges and opportunities that arise in efforts to develop common scientific assessments that are relevant and credible across multiple national circumstances and political cultures. It takes a long-term perspective focused on the interactions of science, assessment and management over periods of a decade or more, rather than concentrating on specific studies or negotiating sessions. Global environmental change is viewed broadly to include not only climate and other atmospheric issues, but also transboundary movements of organisms and chemical toxins.

The Project seeks to achieve progress towards three goals: deepening the critical understanding of the relationships among research, assessment and management in the global environmental arena; enhancing the communication among scholars and practitioners of global environmental assessments; and illuminating the contemporary choices facing the designers of global environmental assessments. It pursues these goals through a three-pronged strategy of competitively awarded fellowships that bring advanced doctoral and post-doctoral students to Harvard; an interdisciplinary training and research program involving faculty and fellows; and annual meetings bringing together scholars and practitioners of assessment.

The core of the Project is its Research Fellows. Fellows spend the year working with one another and project faculty as a Research Group exploring histories, processes and effects of global environmental assessment. Academic year 1997-8 focused specifically on the past three decades of climate change, long-range transport and tropospheric air pollution assessment experience with special attention to Europe and North America. These papers look across a range of particular assessments to examine variation and changes in what has been assessed, explore assessment as a part of a broader pattern of communication, and focus on the dynamics of assessment. The contributions these papers provide has been fundamental to the development of the GEA venture. I look forward to seeing revised versions published in appropriate journals.

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ABSTRACT

A rise in sea level and potential changes in storm climatology (changes in frequency, intensity and geographic distribution of coastal storms) are of utmost relevance to coastal zone policy-making, development, and management. Human welfare, high investments, and significant environmental resources that are intimately linked to economic activities in the coastal zone are at stake. Somewhat surprisingly, however, there is currently rather scant concern with global climatic and related environmental changes among U.S. coastal managers, especially at sub-national levels.

Prior research indicates that highly functional, two-way information exchanges across various levels of scale (international to local) is a necessary if probably not sufficient condition for a greater integration of global change science into decision-making at national and sub-national levels. Thus, the questions arise as to what kind of information sub-national policy- and decision-makers need in order "to factor in" sea-level rise and other climate changes into their policies and management activities? In what form, from whom, and when do they need it? Are these needs known to, and can they be met by, information producers or providers? What is "useful" and credible information? What are the factors and processes -- both inherent in the information itself and in the institutional set-up through which information exchange takes place -- that bring about "effective" information use? In other words, how can the plethora of scientific global change information produced internationally and nationally be made more useful to those who ultimately will have to decide on and implement pragmatic responses to a changing environment at the state, regional, and local levels?

This study addresses these questions in the context of coastal zone management in two U.S. states, Maine and Hawai'i. It demonstrates that more than scale boundaries need to be crossed in order to enable a "local walk" to follow "global talk," that the integration of information and decision systems needs to be coupled such that relevant and credible information flows to practitioners with real decision-making powers, and that significant and maybe a more focused effort is necessary to create a demand for global change-related information that connects with present management problems at different levels of scale and among a broad range of agencies, interest groups, and legislative actors. The study also shows that "local walk" begins to affect at least "regional and state talk" in coastal zone management by way of creating coalitions and networks among concerned actors that are rallied around problems of a particular geographic extent rather than around institutional affiliations that correlate with different levels of scale. The findings are applied to the U.S. National Assessment on the Consequences of Climate Variability and Change and recommendations for its design and implementation are given.

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ACRONYM LIST

Federal

COBRA	Coastal Barrier Resources Act (of 1982 as amended)
CZMA	Coastal Zone Management Act (of 1972 as amended)
CZMP	Coastal Zone Management Program
DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of the Interior
DOT	Department of Transportation
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
IPCC	Intergovernmental Panel on Climate Change
NFIP	National Flood Insurance Program
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NSTC	National Science and Technology Council
NWS	National Weather Service
OCRM	Office of Ocean and Coastal Resource Management (within NOAA)
ORNL	Oak Ridge National Laboratories
OSTP	Office of Science, Technology and Policy
NPS	National Park Service
SGCR	Subcommittee on Global Change Research (within the Committee on Environment and Natural Resources of the President's National Science and Technology Council)
SLR	Sea-level rise
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Service
USGCRP	United States Global Change Research Program
SSRI	Social Science Research Institute (University of Hawai'i)

Hawai'i

DBEDT	Department of Business, Economic Development and Tourism
DLNR	Department of Land and Natural Resources
DMR	Department of Marine Resources
DOH	Department of Health
DOT	Department of Transportation
EWC	East-West Center (Honolulu)
HCZMA	Hawai'i Coastal Zone Management Act (Chapter 205-A)
HCZMP	Hawai'i Coastal Zone Management Program
HHRF	Hawai'i Hurricane Relief Fund
HRS	Hawai'i Revised Statutes
MACZMAG	Marine and Coastal Zone Management Advisory Group
ORMP	Ocean Resources Management Plan
SMA	Special Management Area

Maine

DEP	Department of Environmental Protection
LURC	Land Use Regulation Commission
MCP	Maine Coastal Program
MEMA	Maine Emergency Management Agency
MEPP	Maine Environmental Priorities Project
MLI	Marine Law Institute (University of Maine School of Law in Portland)
MSPO	Maine State Planning Office
SDR	Sand Dune Rules

APPENDIX A: THE VIEW FROM THE NATIONAL LEVEL

The national scale is a central and critical level for the investigation of information flow and decision-making across different levels of scale from the global to the local. International research efforts like global environmental assessments are constituted of nationally based researchers or research teams and often supported through national research programs. Likewise, international legal agreements on global matters like environmental or climate change are negotiated by representatives of national governments and would have to pass through federal institutions for ratification and implementation. The role of the federal government and of the national level research activity with regard to global change intersects with the federal government's responsibility for coastal zone management. The discussion below thus sets out from a description of these responsibilities and activities at the federal level both in coastal zone management and in global change research and information provision. This review will include a summary of significant sea-level rise assessments and their cross-scale components. This will demonstrate what cross-agency and cross-scale linkages exist to sub-national decision-makers, who the involved players are, and what information they share.

The Legal Basis for State-Federal Interactions in Coastal Zone Management

Coastal zone management in the United States is first and foremost framed by the Coastal Zone Management Act (CZMA) of 1972 (US Code Congressional and Administrative News 1972) as amended, and reauthorized as recently as 1996. The Act serves as framework legislation which sets broad national policy goals but which leaves it up to the states whether or not they want to participate in the federal Coastal Zone Management Program and, if so, in large measure how to achieve and implement its goals. To assure implementation of the federal coastal zone management program goals, state coastal programs need federal approval and are regularly reviewed and updated. With federal approval, states can receive funds and technical assistance from the Office of Ocean and Coastal Resource Management (OCRM within the National Oceanic and Atmospheric Administration (NOAA)) to implement their program goals. Since 1990, states can get additional funds -- through so-called Section 309 Enhancement Grants -- to further their progress on state-defined priority areas (US Code Congressional and Administrative News 1990).

In addition to the CZMA, there are a number of other federal laws that pertain to coastal management, for example, the management of coastal flood plains, emergencies, harbors and transportation, marine and fisheries resources, water quality, and species and habitat protection (Center for Urban and Regional Studies 1991; Godschalk 1992; Knecht and Archer 1993; Beatley, David Brower et al. 1994; Platt 1994; Platt 1996). Prior to the creation of the federal CZMP, in 1966, Congress passed the National Sea Grant College Program Act in order to address practical coastal zone and marine resource management concerns. Sea Grant supports research, develops materials for school and general public education, provides outreach and extension services to coastal and marine resource managers, and assists in technology transfer (National Sea Grant 1998). In years past, Sea Grant treated global environmental change as a priority area by supporting both research and outreach on the topic, but global change no longer

enjoys this priority status and receives no special support anymore (Shea 1998a; Kumabe 1998, B. Miller 1998).

As a result of the federalist philosophy underlying the CZMA and the multitude of other relevant national laws, the federal-state relationship on coastal issues is complex and reflects a delicate balance of (and at times, struggle over) authority in coastal resource management. A large number of federal departments and agencies deal with coastal issues, including the

- Department of Commerce (DOC) with the National Oceanic and Atmospheric Administration (NOAA) and its many programs and services, including the National and Marine Fisheries Service (NMFS), the National Ocean Service (NOS) and its Office of Ocean and Coastal Resource Management (OCRM), the National Weather Service (NWS), and the Sea Grant College Program;
- Department of the Interior (DOI) with its Fish and Wildlife Service (FWS), the National Park Service (NPS), the United States Geological Service (USGS), and the administrative responsibility for the Coastal Barriers Resources Act (COBRA);
- Department of State;
- Departments of Defense, Army, and Navy;
- Department of Transportation (DOT) which includes the Coast Guard;
- Department of Agriculture (USDA), and
- several federal administrative agencies, of which the most relevant in this context are the Environmental Protection Agency (EPA) – which administers for example the National Estuarine Research Reserve Program -- and the Federal Emergency Management Agency (FEMA) – which oversees the National Flood Insurance Program.

Multiple other links between the state and federal agency levels exist with regard to coastal affairs, including where states and sub-state entities need to comply with federal permit requirements (for example, obtaining dredging permits or compiling environmental impact statements), where states can obtain additional technical assistance or apply for research funds from other federal agencies, or where federal institutions manage coastal areas (for example, national parks, wildlife refuges, national estuarine research reserves, or military installations). Also, according to the federal consistency provision of the CZMA, every time a federal agency has the lead on a project in the state-defined coastal zone, it needs to acquire all necessary state permits and comply with state coastal laws.

Federally Sponsored Global Change and Sea-Level Rise Research and Assessments

The United States Global Change Research Program

The plethora of global change research initiated, coordinated, and funded at the federal level occurs since 1989 under the umbrella of the United States Global Change Research Program which is defined in the U.S. Global Change Research Act of 1990.[12,13]

The Global Change Research Act states in its legislative findings (Title I, Sec. 101) that the "development of effective policies to abate, mitigate and cope with global change will rely on greatly improved scientific understanding of global environmental processes..." and further that

"an effective federal research program will require efficient interagency coordination, and coordination with the research activities of state, private and international entities." It asks in Sec. 102 that the coordinators of the USGCRP "consult with actual and potential users of the results of the Program to ensure that such results are useful in developing national and international policy responses to global change."

The Global Change Research Act requires that these research results are made available to potential users through an information gathering and dissemination service (Title I, Sec. 104, (d)). The SGCR responded in 1993 by establishing the Global Change Research and Information Office (GCRIO). It "performs outreach services to both domestic (federal, state, and local) and international target audiences (including governments, institutions, researchers, educators, students, and the general public)" (USGCRP 1998c).[14] None of my sub-national interviewees -- when asked about where they do or would go for information on global change issues -- mentioned the GCRIO as a (potential) source. Some, however, mused that they would search the internet which would open the door to this information clearinghouse. The interview findings suggest either that the outreach services are not reaching the target audience or that there is insufficient effort on behalf of the GCRIO to bring itself to the attention of the potential user community.

The Global Change Research Act thus establishes the institutional framework for interagency cooperation on global change issues at the federal level, and for the coordination of global change research efforts and communication of global change research results and information across different governmental levels (from the international to the local) and across constituencies (i.e., policy- and decision-makers within government, the scientific community, (unspecified) stakeholders, and industry). In reiterating an Office of Technology Assessment report (Office of Technology Assessment 1993), Pielke cautioned that "the (USGCR) program will likely produce 'good science' but fail to provide 'usable information' on which policy decisions relating to global change can be based" (Pielke 1994, p.315).[15] In his view, the USGCRP lacks a deliberate process component in which the 'good science' is continuously assessed in light of concrete policy problems and response options. Cross-scale exchange of usable information by this definition then means to generate information in close encounter with the policy processes at different levels of scale, i.e., simultaneously to cut across spatial, temporal, and science/policy boundaries. Interviews with individuals operating at sub-national levels of scale can provide at least partial (one-sided) evidence for federal agencies' and national institutions' participation in this kind of cross-scale communication and cooperation (see Appendices B and D).

The Federal Link Between Global Change and Coastal Zone Management

Both the federal CZMP and the USGCRP are multi-agency efforts with many of the same agencies involved in both programs. The question seems obvious to ask what has happened at the federal level in terms of global change since the passing of the US Global Change Research Act and whether, and if so how, these global change efforts link up with the federal involvement in coastal zone management. Because of the limited research at the federal level, the answer to these questions can only be partial.

In 1990, global change figured high on the political agenda of the US Congress. Coincidentally,

it was also the year in which the federal Coastal Zone Management Act was up for re-authorization. Preceded by years of agency-level research on global change impacts, the amended CZMA of 1990 (and maintained in the reauthorized CZMA of 1996) contains in its legislative findings the following paragraph on global warming and its potential impacts on the coastal zone (US Code Congressional and Administrative News 1972, Section 6202):

> "Global warming could result in significant global sea level rise by 2050 resulting from ocean expansion, the melting of snow and ice, and the gradual melting of the polar ice cap. Sea level rise will result in the loss of natural resources and will contribute to the salinization of drinking water supplies. Sea level rise will also result in damage to properties, infrastructures, and public works. There is a growing need to plan for sea level rise." [16]

Congressional Research Service employee and former president of the Coastal Society, Jeffrey Zinn, stated in 1996 that much of the interest in global change that was prevalent during the late 1980s and early 1990s "has gone by the wayside now... (There is) not a lot of interest in pursuing that at the federal level" (Zinn 1996). This perception was confirmed by EPA's Jim Titus (Titus 1996), one of the strongest and most visible supporters within the federal government of sea-level rise research and policy-making, when he conceded that "to my current boss, it is not as important to get people to act on behalf of SLR as it was to Hoffman," (the former Director of the Office of Policy, Planning and Evaluation (OPPE) within the EPA).[17] At OCRM – the implementing branch of the federal CZMP within NOAA – there seems to not have been any programmatic shift after 1990 toward aiding states in taking SLR into account in implementing their coastal zone management programs (see below for a discussion of OCRM and its linkage to the National Assessment). The fact remains, however, that in 1990 -- with the passing of the USGCRA and the amended CZMA state coastal programs became eligible for federal funds earmarked for the investigation of global change and sea-level rise impacts and responses at sub-national levels of scale.

In the interim, much federal and federally sponsored activity and interest in global change and sea-level rise issues has occurred away from the limelight of media attention, at the program and staff levels where the implementation of the USGCRP is carried out. Only in the last couple of years, through several events that precipitated on the international scene, has White House and other high level political interest in global change issues been re- invigorated -- including the 1995 release of the Second Assessment report of the IPCC; the Kyoto negotiations on the UN Framework Convention on Climate Change in December of 1997 with all the federal publicity events and national conferences leading up to them; and the emerging National Assessment of the Consequences of Climate Variability and Climate Change launched in 1997.

Federally Sponsored, National and Regional Sea-Level Rise Assessments

Federally sponsored research of global change issues did not begin with the passing of the USGCRP. Rather, the global change program framed, formalized, and coordinated many ongoing efforts and opened up opportunities for additional research and assessment. There is a significant history dating back to at least the early 1980s of sea-level rise research and scientific assessments of the state of knowledge in the pertinent sciences (National Research Council 1983; 1987; 1990; Daniels, Gornitz et al. 1992; Gornitz, Daniels et al. 1994).

Important federal investment has been made in basic oceanic science and SLR monitoring, but the focus of the more visible SLR assessments discussed below has been mostly on impacts. Federal agencies also sponsored several regional workshops on the topic both as a way to raise awareness for the potential impacts of sea-level rise, to educate sub-national policy-makers and coastal zone managers, and to elicit input on research and information needs from the practitioner community (Mehta and Cushman 1989; Cicin-Sain, 1996; Rappa, Tomlinson et al. 1995).

Among the most visible federal SLR-related efforts is the research, assessment, and outreach conducted by the EPA since the early 1980s (e.g., Hoffman 1983; Barth and Titus 1984).[18] As part of a much broader global change impact assessment for the US, presented by Smith and Tirpak as a multi-volume report to Congress in 1989 (Smith and Tirpak 1989), one volume was entirely dedicated to the potential impacts of sea-level rise on the US coastal zone. For much of the 1990s it served as the reference report on SLR impacts in the US. EPA's Jim Titus, besides conducting a series of state and estuary-based case studies, was instrumental in compiling this scientific assessment. As indicated above, the EPA is less visible politically now with its sea-level rise work, however, the agency continues to sponsor global change and sea-level rise research and to conduct its own research, the latest of which – a survey of climate and sea-level rise experts on the probability of sea-level rise predictions -- is summarized in (Titus and Narayanan 1995).

The EPA also has offered research funds to states to assess the impacts and response options to sea-level rise at sub-national levels. These studies generally involve interdisciplinary teams of researchers (e.g., geologists, ecologists, economists, legal scholars, and other social scientists) and representatives of state agencies involved with coastal zone management. While I was unable to ascertain data on how many US coastal states have responded to the EPA's RFP on sea-level rise and how many have received such funding, previous research has shown that such federal funding is important in helping global change issues onto the state and local research agenda (National Research Council 1995, p.54; Moser 1997).[19]

Previous research (Moser 1997) and this current study show that in the majority of cases only local workshop participants, sponsoring agencies, and interested scientists are aware of these efforts and some collect these studies, assessments, and workshop proceedings in their offices. Unsurprisingly, actual participation in a study or workshop seems to be the strongest predictor of interviewees' awareness of these federally sponsored efforts, and hence varying degrees of awareness and knowledge of the discussion or study topics. There is no evidence from my interviews at sub-national levels, however, that the information contained in these reports has entered any sub-national decision-making. Federally sponsored research of sea-level rise impacts and response options for individual states and state greenhouse gas inventories on the other hand seem to have a broader and more complex influence on decision-making and I will return to it in Appendices B and D below.

The U.S. National Assessment of the Consequences of Climate Variability and Change

The Global Change Research Act described above requires that a national assessment be prepared of the consequences (i.e., challenges and opportunities) that climate variability and change pose to the United States over the next 25-100 years (Title I, Sect. 106; hereafter the National Assessment).[20] The USGCRP, in cooperation with the Office of Science, Technology and Policy (OSTP), has been engaged since 1997 in a major planning effort to implement this National Assessment. The National Assessment involves federal governmental agencies, scientists, the private sector, sub-national governmental agencies, non-governmental organizations, and other "stakeholders." In its focus on climate-sensitive impact domains (or sectors – one of them being the US coastal zone), on existing vulnerabilities, the generation of a small number of climate change scenarios, and its assessment of response options and research needs, the National Assessment very much resembles previous national and international climate change assessments.

Maybe its most remarkable – and certainly most intriguing and distinguishing trait with regard to cross-scale information and decision systems – however, is its regional component (on which I focus most of my attention in subsequent discussions). Basically, the National Assessment was designed to stand on two major columns, namely a national sectoral assessment – which could be thought of as a more traditional top-down scientific effort -- and second, a series of integrated regionally based assessments designed as bottom-up processes to inform and engage sub-national policy and decision-makers, scientists, and other interested people from the public and private sectors. These two components are to be integrated in a national synthesis report. The regional assessments (for 18 regions plus one disjointed region comprised of all Native American lands) were thought of as the primary vehicle to raise awareness of global change issues at the regional and local level, to provide an accessible forum to define global change challenges and opportunities for a specific region, to discuss response options, to prioritize research and information needs, and to begin to form regional networks among the scientific and practitioner communities to facilitate information exchange and decision-making. These regional assessments were and are still at present being initiated by regional workshops which are meant to to scope out the issues to be addressed in an integrated regional assessment, to build momentum for that effort, to raise awareness and educate interested parties about global change concerns, and to begin the process of building regional networks to support regular communication and information exchange among scientists, governmental agencies, and business and community leaders.

This two-pronged design of the National Assessment and especially of the bottom-up, regional component along with a series of principles to guide the assessment process is viewed by some involved players as nothing short of a paradigm shift, as it implies a thinking of assessments no longer as simply scientific synthesis reports or products but also as long-term, iterative, communicative processes as described above.[21,22] At present, according to several close observers, however, several observations seem to converge to indicate that this First National Assessment is moving away from its process-orientation and toward a top-down product-orientation, i.e., the traditional model of producing a scientific assessment and report which is due for publication and submission to Congress and the President on January 1, 2000. Among these indications are:

- the absence of any direct involvement of the regions in the detailed design and planning of the First National Assessment;
- the absence (so far) of a regional counterpart to the National Assessment Synthesis Team, i.e., a Regional Council made up of the regional workshop coordinators, which together with the first point, does not convey the role of regions as equal partners in the assessment process;
- the very tight assessment schedule and hence immense time pressure that makes a meaningful involvement of interested parties very difficult (for example, the synthesis report is scheduled to be written at the same time that the regional assessments are being done, which raises the question what of the regional assessment results can actually enter the synthesis report);
- continuing debates over the viability, advantages, and disadvantages of maintaining 18+1 regions for the regional assessment component and the suggestion to merge these regions into a small number of mega-regions (USGCRP 1998d); several personal communications with David Cash (KSG-HU), Eileen Shea (CARE), Brent Yarnal (Penn State), Mike Hall (NOAA-Office of Global Programs), Tom Wilbanks (ORNL), and Ted Parson (KSG-HU), from January-April 1998).

It is too early to tell whether the paradigm shift indicated on paper will in fact bear out in practice. The National Assessment process has the potential to be a model for a cross-scale, cross-agency, cross-constituency assessment process. On the other hand, one can also envision several political implications of a failure to follow through with the original two-pronged design of the assessment process, including:

- disenfranchisement of the regions, i.e., those engaged in the regional workshops, i.e., loss of the scientific and (maybe more importantly) political momentum generated through the workshops;
- loss of credibility of those who organized or took lead roles in the regional workshops, who engaged hundreds of participants with the promise of a new federal-regional partnership;
- reinforcement of any pre-existing distrust in federally sponsored scientific efforts;
- distrust or even dismissal of any national-level climate change assessment or information; and hence
- loss of any nascent support for political decisions and actions necessary to respond to the challenges that climate variability and change may pose locally or nationally.

I conclude this section with one example of how the National Assessment, and in particular its regional component, is reflecting back on some of the programmatic activities of federal agencies involved in coastal issues. After the Hawai'i-Pacific Regional Workshop in March 1998, two coastal zone program coordinators of the region who had participated in the Workshop, met with OCRM personnel in Washington. They expressed some concern over the apparent lack of OCRM's engagement in the National Assessment. This, in turn prompted OCRM staff to request a briefing on the National Assessment from Eileen Shea who said that her briefing was the first time OCRM staff had heard about the National Assessment, for some even the first time they learned about the USGCRP, and that most did not know what their role ought to be in the National Assessment. This incident may be an anomaly or it could reflect a lack of integration between information production (global change research activities) and decision-making (e.g., coastal policy implementation) at the federal level. In other words, if the

providers and users of global change information are not linked within one of the most important agencies at one level of scale, they probably ought not be expected to be linked across levels of scale.

National Non-Governmental Organizations and Sea-Level Rise

To complete this overview of national-scale activities, I take a brief look at non-governmental activity at the national level regarding sea-level rise and related global change and coastal zone management issues. The focus here is on the activities of non-governmental and professional organizations primarily aimed at or organized at the national level while recognizing that their members and sometimes their institutional branches are also or even more active at sub-national levels of scale. Such organizations can produce and disseminate information and also provide fora and platforms for discussion of global change issues. Clearly, they also have some political power to affect political and scientific agendas and to command media attention and thus reach across scales and audiences.

Several environmental non-governmental organizations (NGOs) are active in coastal matters on the national scene, among them especially the Natural Resources Defense Council (NRDC), the Environmental Defense Fund (EDF), the Sierra Club, and the Coast Alliance – an umbrella organization or Washington-based political mouthpiece for a diverse set of state and local coastal NGOs (although its focus is broader than merely environmental) (for additional US-based or US-active coastal NGOs see (Coastweb Consulting 1998)). Except for the Coast Alliance, the other NGOs also have an expressed interest in global change matters as evidenced in their publications and webpages. Their staff scientists engage in reviews of the scientific literature to translate that information into lay language and they frequently lobby and testify before Congress on coastal and environmental change concerns. The extent to which information processed in their national headquarters travels across scale presumably depends to some degree on their organizational structure, i.e., whether there are local chapters or member organizations (as in the cases of the Sierra Club and the Coast Alliance respectively). Drawing on the one-sided empirical evidence underlying this study, however, none of my sub-national interviewees indicated that they received any sea-level rise pertinent information from any of these sources.

A similar conclusion must be drawn for professional organizations like the Association of State Flood Plain Managers (ASFPM), the American Planning Association (APA), the National Emergency Managers Association (NEMA), the Coastal Society, or the Coastal States Organization (CSO), and others which concern themselves with various aspects of coastal zone management. While they all provide fora where emerging coastal or hazard management concerns like sea-level rise and its associated risks could be raised, none of the sub-national interviewees attending respective national meetings mentioned that they ever received any such information or have engaged in global change or sea-level rise discussions there (e.g., Sidell 1998; Young 1998).

One may speculate as to the reasons why professional organizations broadly concerned with coastal management have until now remained silent on an issue that has been on the scientific and on and off the national political agenda for almost two decades. There may be little overlap between their members and hence leadership (mostly coastal and hazard management

practitioners) and the scientific community that is most interested in global change and sea-level rise. A related reason may be that these practitioners bring state concerns to their national fora; with much of the scientific climate change impact literature being global or at best national, averaged and/or qualitative in nature, they may simply not see how their state concerns relate to information about global processes. If that were the case, a third potential explanation may come into play, namely that there may be too few people at the national level of scale who can not only translate scientific information into lay language, but who can also initiate or suggest a reframing of global or national concerns into sub-national matters or embed the global environmental issues into sub-national management strategies (Godschalk 1996). As suggested, for example, by EPA's Jim Titus (Titus 1996), "people don't respond to sea-level rise, they respond to erosion. If anything they understand that sea-level rise causes erosion, but it would be more effective to just talk to them about erosion and not mention sea-level rise." Several other scientists and practitioners made similar comments (Brower 1996; Davidson 1996; Pilkey 1996b) and I will return to the issue of reframing again in Appendices B, C, and D. Other contributing factors may be that there are other problems which rank higher on the priority list; that "there is no sea-level rise lobby" (Brower 1996) to push the issue onto the agenda of relevant organizations or to help it be widely heard; or that the perceived uncertainty of scientific information about global climate change leads people to suppress or dismiss the significance of its possible consequences, and as a result that all action that is currently thought to be necessary is exactly what is being done: more science (Coppock 1996; Lecomte 1996). Additional interviews are needed to support, refine, or dismiss any of these possible explanations.

Conclusions

The above discussion has shown that the legal, administrative, and political structures at the national level are in principle in place to support the production of scientific information, to provide information clearinghouses and formal information exchange channels, and to promote the linking of pre-existing (ongoing) coastal zone management efforts with the emerging challenges connected with global climate change. From the limited evidence available, it is also obvious that some of the available channels and fora don't seem to be used and that most of the global change information produced at or available through federal agencies and national organizations does not seem to reach the policy-making and practitioner communities at the national or sub-national levels of scale. The speculative reasons for a lack of information exchange on SLR raised in the previous subsection may apply more generally to all actors and institutions discussed above but they require more empirical testing. Pertinent to federal agencies subject to changes in political winds, there may be the additional factor of personnel turn-over with a change in administration. That factor should not be underestimated in explaining changes in intellectual and political direction in a research program or agency and in institutional memory loss (Titus 1996; Zinn 1996) and the consequences those may have on information production and dissemination.

The previous sections also seem to indicate that the rifts <u>between levels</u> of scale (e.g., between levels of governance) may be secondary to those between research and policy- or decision-making <u>at one level</u> of scale. Establishing formal or even informal information exchange channels and generating or providing information appears to be insufficient to assure actual information flow and use. Thus, it seems necessary to have persistent information translators

and brokers within and between levels of scale. Until climate change information can be down-scaled to the various levels where actual responses are to be implemented, this information brokerage may only (but importantly) serve as a way to raise awareness for the issues and to slowly build a global change-literate constituency, or differently put, a decision-maker demand for global change information at national and sub-national levels. The research reported in Appendices B and D will show among other things to what extent such an information demand currently exists.

APPENDIX B: MAINE – THE WAY THINGS "SHOULD" BE?

The exploration of cross-scale information exchange and decision-making at the sub-national level looks first the state that greets its visitors with the promising motto "the way life should be." Are there information and decision systems in place here that could model cross-scale integration of information and decision-making in support of management of global environmental risks? This appendix explores the extent to which global change issues, especially sea-level rise and changing coastal storm patterns matter to Mainers, the sources of information people in- and outside of government have available, the channels of information exchange, the kind of information needed and/or used in decision-making, and the permanent or ad hoc collaboration between players in coastal zone management. I begin these discussions in the first section below with a very brief sketch of the physiographic and socioeconomic characteristics of Maine's coast in order to give a qualitative indication of its vulnerability to sea-level rise and associated coastal hazards. The following section describes the legal basis and institutional structure for coastal zone management in Maine. Then I review the available state-specific scientific information on SLR, climate change, and related hazards, followed by a summary of coastal policies and decision-making and other governmental activity to date regarding SLR and climate change. Finally, I report the more specific results of the mostly interview-based empirical research about information exchange and the integration of scientific information in coastal decision-making in Maine and draw several conclusions in the final section.

Not Just Rugged Shores: Characteristics of Maine's Coast

Maine's coast is -- depending on the scale at which it is measured -- between 2,500 and 3,700 miles long, by far the third longest shoreline of any U.S. state after Alaska and Florida. It is commonly divided into three physio-graphically distinct regions (Kendall 1987; Kelley, Kelley et al. 1989; see **Figure 3**): (1) the Southwest Coast from Kittery to Cape Elizabeth -- southern Maine's principal tourist attraction known for its splendid beaches and wildlife-rich estuarine marsh areas; (2) the Midcoast from just north of Portland to Owls Head -- a ragged coast with eroding bluffs and wide mud flats, few small pocket beaches, smaller estuarine salt marshes; and finally (3) the Downeast Coast including the Penobscot Bay to the border with Canada – the stereotypical rocky Maine coast with broad bays, large igneous or metamorphic islands, and rare small sandy pocket beaches. Off the northern Mid- and Downeast coasts are Maine's countless islands of which 14 are permanently settled.[23]

Maine's coast is as much the result of its physical geology as its recent history of SLR. That recent history is varied and interesting because it combines the worldwide influences of a post-glacial eustatic SLR with local relative land movement, including isostatic rebound after deglaciation and earthquake-related submergence[24] (Apollonio 1979; Anderson and Borns (eds.) 1989; Kelley, Kelley et al. 1989; Shipp, Belknap et al. 1991; Kelley 1992; Gehrels and Belknap 1993; Barnhardt and Kelley 1995; Barnhardt 1995; Dickson and Kelley 1995; Kelley, Dickson et al. 1996; Duffy and Dickson 1998; Maine Geological Survey n.d.). Figure 2 shows the average, smoothed sea-level curve for Maine which reflects relative sea-level fall due to isostatic rebound and as that land movement came to an end a considerable SLR since. Note, however, that SLR rates vary considerably along the coast: at Portland, the contemporary

average rate of SLR is 2.2 mm/year (measured since 1912) and slightly slower between 1950-1986 (1.9 mm/year) -- a rate that is 10 times faster than that of 4000 years BP and 100 times that of 1000 years BP (Kelley, Dickson et al. 1996). Because of local subsidence, the SLR trends are even faster in the southern most part of the state and considerably faster in the northeastern most part and Bay of Fundy area (Kelley 1992).

Researchers project that accelerated sea-level rise (SLR) will affect the sandy beaches, wetlands and estuarine coast considerably, but less so the bluffs (as long as sand supplies are available), as they are more vulnerable to the direct impacts of inundation and storm-related erosion (Marine Law Institute (University of Maine School of Law), Maine State Planning Office et al. 1995). So while there is only a small unconsolidated stretch of highly vulnerable coastline (according to various estimates between 30 and 300 miles (Conkling 1981; Kendall 1987; Marine Law Institute (University of Maine School of Law), Maine State Planning Office et al. 1995),[25] the greatest extent of it is in the southern part of the state which is subsiding at a significant rate (see below), and which is the most densely populated and developed portion of Maine's coast.[26]

This physiographic setting and the socioeconomic activity that characterizes the Maine coast provides some indication of the vulnerability of Maine to the impacts of SLR and at the same time highlights some of the management challenges for coastal zone management. First and foremost, the coastal tourism industry in Maine is a strong growth industry; it attracts not only increasing numbers of Mainers seeking employment in this area, but also growing numbers of vacationers who require accommodations, services, and the structural facilities that support recreational entertainment (e.g., boating ramps, beach-related development). Increasing development pressures on the coastal natural resource base in the future is a certainty. At the same time, the northeast fishing industry has been in severe crisis over the last few years, and it is yet unclear in what form and at what level it will continue to exist in the future. The industry is already under stress and presumably sensitive to any additional environmental impacts that could diminish their harvests. The urban and industrial development in southern Maine is significant and has lead to considerable structural protection of the shoreline. There is little room for new oceanfront development other than redevelopment and in-filling. This makes oceanfront property highly valuable, scarce, and -- in the case of more rapidly encroaching seas, i.e., via increasing erosion problems -- prone to big economic losses. Water-dependent uses, activities, and supporting infrastructure are also greatly at risk.

In short, even though Maine does not have that much highly vulnerable shoreline (notably beaches), where it does have such it also experiences the greatest development pressures. Consequently, the southern shores of the state are most at risk.

The Legal Basis and Institutional Structure of Coastal Zone Management in Maine

The Maine Coastal Program (MCP) was developed in the early 1970s and – as is required by the CZMA -- approved by the federal government in 1978. The major concerns leading to the development of the Program were those of the environmental and aesthetic impacts of development and resource use conflicts.[27] The Program was neither based on one single piece of legislation (but rather 13), nor carried out by one single state agency (but rather seven) and involved four federal and eight state-based, non-governmental institutions. This linked system

of laws and agencies has not changed significantly since (Maine State Planning Office/Maine Coastal Program 1988; Maine State Planning Office/Maine Coastal Program 1993; Rudoff 1996; Vestal 1996), is bemoaned by some ("fragmentation") (Hershman 1981), and appreciated as a positive trait by others ("shared responsibility") (Maine State Planning Office/Maine Coastal Program 1988). The program basically resulted from networking environmental (but not necessarily coast-specific) legislation that had been written during the environmental era of the 1970s (for a detailed review see (Moser 1997)).

Institutionally, the coastal program is housed within the State Planning Office (MSPO). The MSPO, however, is not a permitting agency; it administers and coordinates the program, and program officials conduct and oversee projects, provide financial assistance, technical assistance (technical information, model ordinances, professional training, etc.) and outreach and educational materials to implementing state and local agencies and the public at large (Dest 1998; Rudoff 1998). Other related programs within the MSPO with similar types of responsibilities but different foci include the Floodplain Management Program which administers the National Flood Insurance Program (NFIP), the Community Assistance Program which helps communities with spatial planning and economic and community development (Maine State Planning Office 1998; Sidell 1998; Valle 1998), the Land For Maine's Future Board (Maine State Planning Office/Land for Maine's Future Board 1995), or the recently completed work of the Land Acquisition Priorities Advisory Committee (Maine State Planning Office/Land Acquisition Priorities Advisory Committee 1997a; DesMeules 1998). The Department of Environmental Protection (DEP) (with its four regional offices) is the main implementing agency of coastal and other environmental, zoning, and shoreland development legislation (Van Cott 1998). It ensures the implementation of federal and state environmental laws through direct permitting and overseeing the compliance of municipalities with rules and regulations. Most permit applications are dealt with by DEP staff whereas contested cases or ones with major potential environmental impacts are decided by the DEP's Board of Environmental Protection. The Department of Conservation plays also an important role in coastal zone management since it houses the Maine Geological Survey – a critically important local information source regarding coastal hazards, sea-level rise, and erosion problems (Dickson 1998; Kelley 1998). The Department of Conservation is also responsible for (coastal) state parks and public lands, and is home of the Land Use Regulation Commission (LURC), a bureau that plans and reviews development and other land uses in unorganized townships (Todd 1998).[28] Finally, at the state level, the Maine Emergency Management Agency (MEMA) forms the first line of defense in case of disaster, including coastal emergencies. MEMA also coordinates and facilitates hazard mitigation efforts funded through FEMA (Maloney 1998).[29]

State planning and community development efforts are channeled through regional planning councils. Thus, instead of the MSPO providing technical and financial assistance to some 400 communities individually, the MSPO works through a small number of regional planning councils, e.g., the Southern Maine Regional Planning Commission (Albert 1998), the Mid-Coast Regional Planning Commission (Martucci 1998) etc., and municipalities approach these regional councils with quests for assistance. These Planning Councils offer model ordinances, land use plan models, professional advice, monthly brown bag lunches for local planners to exchange information, discuss problems and get educated on specific topics (Bernstein 1998; Roedner 1998), or to obtain a variety of written information (e.g., small packages of fact sheets informing about erosion hazards and how to remedy them). Finally, at the local level of

government, municipal officials – planners, code officers, and so on – manage the implementation of state coastal policies through zoning ordinances, flood ordinances, and other regulations (Bernstein 1998; Lockman 1998; Roedner 1998). An individual wanting to build a structure or alter a coastal area (e.g., wetlands) needs to acquire federal, state, and local permits to do so. Generally, the first point of contact for individuals entering the permitting process, is the local code enforcement officer who informs the applicant of the permitting process, all needed permits, the underlying policies and regulations, and the information an applicant needs to supply in order for permits to be processed (Gagnon 1998). Some of that information is available locally, other information needs to be acquired from state agencies or produced with the help of consultants.

This description of the governmental structure from the state-level to the individual at the local level gives a first indication of who the players and institutional channels are in coastal zone management in Maine. The picture is incomplete, however, without showing additional direct links to the federal level and without including the non-governmental, private sector which plays a significant role in coastal issues in Maine. First and foremost among the NGOs is the Maine Audubon Society,[30] which is the most active environmental group in coastal matters (Cost 1998). The Maine Coast Heritage Trust is a state-wide umbrella organization for numerous local land trusts and active in coastal land preservation and sustainable coastal resource use (Hamilton 1996; Bailey 1998). The Island Institute – a private, non-profit research, education and outreach institution – is mainly focused on the inhabited islands and the working coastal waterfront (Naegel 1996; Naegel 1998; Platt 1998). Finally, Coastal Enterprises Inc. should be mentioned as one prominent example of a private, non-profit community development corporation that serves as a link between governmental and non-governmental institutions, municipalities, and private citizens. The organization is increasingly concerned with environmentally and economically sustainable coastal resource use (Coastal Enterprises Inc. 1996; Dickstein, Branscomb et al. 1997; Dickstein 1998).[31]

There are various types of direct connections of state and local institutions to federal agencies, including through management programs (NOAA-OCRM as the parent agency to the MCP), regulations (e.g., administered through the EPA, NFWS etc.), funding (e.g., EPA support for the Casco Bay and Damariscotta River Estuary Projects and other regional networks of local institutions (e.g., the Penobscot Bay Network) designed to improve coastal zone management), permanent research and educational institutions (e.g., the Wells National Estuarine Research Reserve) (Dionne 1998), and through local offices of federal agencies (EPA-Region I in Boston; USACE-Region I in Waltham, MA and a local Maine office; FEMA-Region I in Boston and its local connections through the Floodplain Management Program within MSPO and through the state emergency management agency). Individuals within and outside government form the links to national-level professional or other NGOs, e.g., the National Floodplain Management Association or the Coast Alliance.

Finally, the scientific community within academia appears to be a recognized and essential player in coastal issues in Maine and it provides additional connections to federal programs either through regular research funding or through formal institutional links. Researchers from various University of Maine campuses, the College of the Atlantic, the University of Southern Maine and other smaller colleges with expertise in geology, oceanography, biology, marine resource management, economics, and jurisprudence are among the most frequently consulted

on coastal matters (Belknapp 1998; Colgan 1998; Dionne 1998; Kelley 1998); see also previous research by (Moser 1997)). Importantly, the University of Maine, Orono, is one of the Sea Grant colleges[32] and provides cooperative extension services to local communities (Beard 1998).[33]

State-Specific Sea-Level Rise and Climate Change Research to Date

Maine's biggest assessment effort of global change-induced SLR to date is a large EPA-funded study jointly conducted by the Maine State Planning Office, the University of Maine's Marine Law Institute, and the Maine Geological Survey in 1995 (Marine Law Institute et al. 1995) (see also below). This study aimed to undertake "Maine's first systematic assessment of its vulnerability to a change in shoreline position as a result of accelerated SLR associated with global climate change" (Marine Law Institute et al. 1995, p.S-1). The report entitled Anticipatory Planning for Sea-Level Rise Along the Coast of Maine is -- in the context of a general dearth of such studies at sub-national levels in the US -- a remarkable document that includes a physical-geographic analysis of SLR impacts (mainly based on past impacts of historical SLR in Maine and the development of scenarios), an economic vulnerability assessment and cost-benefit analysis of various response options, and a review of the entire set of laws and regulations that pertain to the coastal zone and that could be drawn upon or amended to address SLR. The assessment uses four different scenarios, each with a low, medium, and high SLR projection, which are the results of combining historical, locally measured rates of SLR with global projections (using IPCC 1990 figures adapted with the help of EPA's SLR-veteran Jim Titus). The report is built on the two fundamental premises that "the state should protect and strengthen the ability of natural systems to adjust to changes in shoreline position, and the state should prevent new development that is likely to interfere with the ability of natural systems to adjust to changes in shoreline position" (Marine Law Institute et al. 1995, p.S-11). The report concludes that "meaningful preparations (for SLR) can take place now, despite scientific uncertainty, by carefully building upon what is already known" (Marine Law Institute et al. 1995, p.S-2), and it ends with a list of 15 recommendations for anticipatory, planning, and regulatory policies and research, education, and further assessment needs.

Sea-Level Rise Policies and Decision-Making to Date

Previous research has shown that to date no concrete policy or regulatory action has followed from this SLR assessment (Moser 1997). The study was done at a time, however, when Maine already had SLR-specific policies and regulations in place. Ever since the initiation of the Maine Coastal Program, the management of development in hazardous coastal areas has been one of the core policy areas (Maine State Planning Office/Maine Coastal Program 1989b; Maine State Planning Office/Maine Coastal Program 1993; Maine State Planning Office/Maine Coastal Program 1997b). In fact, legislation addressing coastal hazards that used SLR as a supporting justification was first passed in Maine just one year after the approval of the MCP. In that early legislation, it is historical (relative) SLR that is alluded to and, by in large, this early official recognition of SLR seems to have gone mostly unnoticed by the public at large and even within governing circles.[34]

In the mid-to-late 1980s, however, accelerated SLR due to global warming got its own (and highly visible) place not only in Maine's coastal laws, but as a pioneering example in the entire

nation, namely in Maine's **Sand Dune Rules** (hereafter SDR)[35] (for further details on the policy history see (Moser 1997)).

Suffice to say that the temporal coincidence of the local political-economic conflicts and the locally emerging awareness of development aesthetics and coastal hazards with the global rise of scientific and political interest in climate change and sea-level rise seems rather haphazard. According to one deeply involved observer of the legislative activities, however, global change had gained sufficient public attention and credibility at that time to justify its use – if opportunistically – as additional leverage to push the SDR through the state legislature (Kelley 1996). The SDR are very explicit about SLR, the uncertainties around it and how it is to be taken into account in deciding over permit applications to develop sand dune areas (see **Appendix C** for excerpts from the law).

The SDR are not the only way in which climate change-induced SLR has received governmental attention in Maine. Governmental agencies have participated or are currently involved in several supra-state, regional efforts that have dealt with climate change (and sea-level rise), albeit ones that have not resulted in any state-specific policy or legislative action and which have not received much public attention in Maine: (1) one DEP employee participated in the New England Regional Climate Change Impacts Workshop – the regional workshop that was part of the National Assessment (University of New Hampshire/Institute for the Study of Earth Oceans and Space 1997; Anderson 1998), but assessed the impact of the conference on Maine as very minor; (2) as part of its climate action plan, Region I of the EPA has launched the New England Global Warming Network (a collaboration of EPA, DOE, state environmental, energy, public utility, planning, and transportation agency officials) (U.S. Environmental Protection Agency 1998) of which Maine is a part, but again, Maine interviewees reported of no specific action that has resulted from this regional collaboration to date.

At the state level, in 1993, then-Governor of Maine McKernan established the Maine Environmental Priorities Project (MEPP), a joint effort among government officials, industry and business representatives, and citizens to "identify, compare and rank environmental problems according to the relative risk they pose to Maine's ecology and to citizen's health and quality of life" (Maine Environmental Priorities Project 1996a, p.ix). Ten environmental problems emerged through that joint scientific-public process including global climate change and its impacts (e.g., sea-level rise). According to the first major report that summarized these problems, their rankings and the reasons for them, global climate change (and SLR) was ranked an issue of <u>medium</u> risk (MEPP, 1996a). The project report notes that Mainers show very low concern for global climate change issues, speculating that this is probably so because direct impacts are hard to see, but that the potential ecological impacts are significant and even though those are uncertain and in many ways unknown, the issue should not be dismissed (Maine Environmental Priorities Project 1995; Maine Environmental Priorities Project 1996a; Maine Environmental Priorities Project 1996b, p.35; Dickson and Kelley 1995). Since this first comparative risk assessment, the MEPP has gone into a second phase of working toward strategies to deal with the identified high-priority issues and to determine the costs of these strategies. At the same time, this largely state-funded project has lost considerably in visibility and because climate change was not considered a high-priority issue, it is not part of these continuing efforts.[36]

A recent review of the Coastal Program (a so-called "309 Assessment") produced through focus group interviews, state-wide surveys, and input from scientists yielded that Maine's coastal residents perceive coastal hazards and erosion problems -- despite the ongoing and repeated crises along the southern and mid-coast -- only as mid-range priority issues (Maine State Planning Office/Maine Coastal Program 1997b). Thus little opportunity exists currently to address SLR within the MCP through the 309 enhancement grants.

In response to an attempt within the DEP to loosen the Sand Dune Rules further, and in response to serious coastal erosion problems in southern Maine,[37] the MSPO and DEP established the Coastal Resources Stakeholder Task Force (Ferdinand 1996; Maine State Planning Office/Maine Coastal Program 1996; Madore 1997; Dickson 1998; Ferdinand 1998; Kelley 1998; Van Cott 1998). The agenda of what specifically and how the Stakeholder Group should address their concerns was determined through a facilitated bottom-up process involving municipal, business, environmental, academic, and state agency representatives and affected citizens (Ferdinand 1996; Madore 1997; Ferdinand 1998).[38] The Stakeholder Group concluded its discussions in early April 1998 by signing off on a report of findings and recommendations for submission to the Governor. Without reference to future climate change-induced SLR, the Task Force stated in its findings,

> "many of our beaches are responding to sea level rise and coastal storms by moving shoreward ... We can not halt the rise of the sea or the assault of northeast storms, but we can minimize risk to property and natural resources as a result of the landward movement of the shoreline and human activities along the coast." (Southern Maine Coastal Stakeholder Group 1997, p.2).

According to Bill Ferdinand (Ferdinand 1998), MSPO representative to the group, the Stakeholder report serves as the basis to initiate legislative changes in order to implement its recommendations, including to manage beach systems on a regional (i.e., geological system) basis and to begin producing such regional beach management plans, to establish a long-term beach monitoring and assessment system through a joint state agency-science-stakeholder effort, and to study the economic side of beach loss as a basis to assess beach nourishment options. The report also asks for more scientific information on beach erosion, coastal hazard, and habitat protection to facilitate the development of beach management plans (Southern Maine Coastal Stakeholder Group 1997, p.4).

The Stakeholder Group is remarkable for the process that guided it, the coming together of interested parties with different interests, goals, and affiliation, but a common sense of urgency to address erosion issues ("they wanted to have a meeting, they had real gripes" (Kelley 1998)). While the effort was regionally based, it included actors from different levels of scale. It was facilitated by an independent discussion leader and included a significant educational component which created not only a deeper scientific understanding of the long-term beach erosion problems but also a sense that southern Maine's erosion problems are not unique – neither to Maine nor to the nation, and that any solutions would be costly and temporary (Dickson 1998; Kelley 1998).

Around the same time, a maybe even more remarkable effort occurred at the local level. Citizens of the city of Saco in southern Maine initiated the creation of the Camp Ellis Beach Erosion Study Committee (through appointment by the mayor) with the charge to lay out the

erosion problems for the city (Roedner 1998; see also Pilkey and Dixon 1996a). After numerous committee meetings and solicitation of public input in which the twelve lay community members struggled over problem definitions and solutions, educated themselves, and solicited input from scientists and state agency staff knowledgeable about coastal processes, the Committee submitted a report to the city council with findings and recommendations (Camp Ellis Beach Erosion Study Committee 1997). The report includes a substantial section on global warming and SLR. It cites the current international consensus on global climate change and SLR and more specific results from EPA SLR impact studies; it reproduces a SLR graph off the internet provided by the American Chemical Society;[39] and it refers to the Maine state Anticipatory Planning for Sea-Level Rise report (which used Camp Ellis as one of the case studies). It is too early to tell what will come of this committed local effort, now that the report has been submitted to the city council. One of the recommendations proposed to institute the ad-hoc group as a standing committee (Roedner 1998). Another recommendation was to communicate with neighboring communities about a joint beach management plan. That – through Rich Roedner -- would create the link to the Southern Maine Regional Stakeholder Group. Hence, the local implementation of these recommendations are at least in part contingent on or related to the larger regional efforts.

Summarizing then the SLR-specific policy and decision-making in Maine, it is safe to conclude (in comparison to other coastal states (see Moser 1997) that Maine is one of the most progressive states in the nation in terms of explicitly recognizing and addressing historical and accelerated SLR through rules and regulations. This holds true even against the backdrop of a public that is largely unaware and maybe even uninterested in global climate change issues (University of New Hampshire/Institute for the Study of Earth Oceans and Space 1997, p.45; MEPP 1996a). While it may still be true that governmental interest in conducting an elaborate SLR study may only have been sparked by EPA's call for proposals,[40] and SLR per se is not a driving force for the state in coastal zone management, there is considerable grassroots pressure to address coastal erosion problems. The extent to which SLR, especially climate change-induced accelerated SLR, comes into play in erosion management debates varies. The explicit treatment of the issue in the Camp Ellis Beach Erosion Committee report is extraordinary to my knowledge. Arguably, when citizens come together to urge governmental agencies to address their erosion concerns and to change the pertinent policies and rules, it is no longer necessary to draw on scientifically uncertain problems perceived to be remote to make their case. When they do, it does not only demonstrate that global change information has found its way to, or was demanded at the local level, but that the concerns of citizens were grave enough to motivate them to educate themselves and go after the information that could help them make a more forceful argument.

Information Exchange and Decision-Making

From the interviews with state agency and municipal officials, scientists, planners, and representatives of non-governmental organizations, a number of common themes emerged regarding the factors that affect information uptake, processing, exchange, and its integration into decision-making. Instead of reporting what works and what doesn't in the information exchange institution by institution, I will discuss these common themes with examples instead and indicate if any of them are specific to a particular level of scale.

Resource constraints and trade-offs

Among the most frequent constraints mentioned by interviewees affecting inter- and intra-agency and cross-scale communication were resource constraints expressed as lack of time, personnel or money. Underlying this theme are the effects of the common modern trend toward less government. Downsizing government means to those agency officials who retain their jobs that they have to do more with the same resources or the same with less resources. While this observation is by no means new or surprising, it has very tangible implications for information flow, e.g., that less information is made available, or that more information is made available through passive databases (e.g., the web), that incoming information cannot or only very selectively be processed, or that there is little time left for information translation and brokering. The latter has implications for the extent to which information will enter decision-making. It also implies that the saliency and immediacy of problems become crucial factors in determining what kind of information about what kinds of problems will be taken up from all the information one could absorb. More than once, interviewees, especially at the local level complained not about the dearth of information but about the abundance of it, asking for guidance as to how to choose from "all that is out there." On the other hand, the resource constraint problem also supports the idea that more frequent and better communication and cooperation could help in sharing and thus reducing the work burden for any one individual or institution.

The resource constraints also affect policy- and decision-making in that they restrict the issues any level of government will and can deal with fiscally. Implementation of SLR adaptation measures costs money and communities will have to make trade-offs between say, expanding schools, buying new fire trucks, repairing roads, or nourishing a beach. While such a measure would have several benefits -- provide more public safety, maintain the resource for coastal tourism, and protect the property tax base – communities yet have to decide on their reasons for such adaptation measures and it will affect the ranking of municipal priorities (Roedner 1998). Clearly, these trade-offs entail difficult policy decisions and may not have much to do with how much or valuable information about global change and sea-level rise is available locally.

Mission, rewards, and professional progress

When resources in the broadest sense constrain what can reasonably be done, a significant amount of extra effort is required on the part of individuals who want to continue providing information services (acquiring, processing, translating, disseminating, and brokering information) to potentially interested parties. Several governmental officials indicated that such extra effort is frequently not appreciated – neither financially nor professionally. To "go the extra mile" then requires independent motivation and usually entails going beyond one's narrower job description, even beyond an agency's mission. For example, the main purpose of one agency or one branch of an institution may be to process permit applications (as many and as fast as possible) while a related agency or branch may be charged with studying the cumulative impacts of development in order to develop recommendations how to limit these impacts. Both agencies or branches may do the best they can and still work on opposite ends of the problem and never find in their job description that they should share their information with each other or take it into account. Several interviewees told of their accidental discoveries that work very much related to their own was going on in another agency or even just "down the hall." While interagency task forces exist precisely to remedy the problems of duplication, inefficiency, and lack of coordination and cooperation, the compartmentalization of various management efforts and its separation from research and outreach is still often a problem.[41]

Similarly, scientists interested in doing public service in their capacity as knowledge producers and providers commonly have to provide such services on their own time (unless they are engaged in research projects with agencies, e.g., with the MSPO or the DEP. While professional progress (e.g., tenure) is commonly said to also depend on community service, the reality is still that breaking out of academic endeavors is rewarded less than research and teaching. This also underscores the still existing cleavage between pure and applied science and the fact that the latter – which frequently implies an active crossing of the science-practice boundary – enjoys lesser esteem in the academic world than the former. Thus there are structural boundaries not just between science and the realm of policy and decision-making but also within each that can hinder information flow and the integration of scientific information into practice.

Leadership

Repeatedly, my interviews revealed the importance of leadership (or the lack thereof) in breaching the boundaries and in taking the lead on redefining agency missions, pursuing new program directions, actively creating linkages between agencies and between government and science, or setting up new ways of dealing with old problems (e.g., the initiation of the Stakeholder Group or the Camp Ellis Beach Erosion Committee; the restructuring of the MSPO; or the production and dissemination of coastal hazards and global change information and the challenging and untiring effort of individuals to improve coastal hazards management). Interviewees frequently wished for more leadership to initiate discussion on how to address larger concerns like global climate and environmental change.

Personalities and personal values

These examples point to a related characteristic of individuals which affects the way they operate in whatever position they find themselves in, namely their personal values toward the environment, toward science, toward people of varying backgrounds and economic status, and toward their own work. Consistently, interviewees appreciated those individuals who "went the extra mile," and who crossed the typical boundaries between agencies, scales, professions, and constituencies. They singled out their genuine ability to listen, to learn, and to "relate" to others as their distinguishing trait. Based on the premise of being unpretentious and non-patronizing, the "trespassers" were then able – in time -- to bring their own messages to the table, i.e., to contribute their insights, to educate, to disseminate information, and to discuss the more contentious implications of scientific information. In other words, personal values and personalities affect the degree to which a mutual trusting relationship can be established and that in turn affects what information can enter into difficult debates.

The interplay between message and messenger

That personal values affect the types of relationships that can be established is, again, not surprising. At sub-national scales, however, where the number of involved players in coastal zone management and the related scientific community gets smaller, i.e., where there is a fairly constant and limited pool of actors, the importance of the interplay between message and messenger (and her or his affiliation) becomes heightened. The small pool of actors makes it possible to build a trustful relationship with the messenger over time. In turn it enables habitually used information flow channels to become established, which is an important contributing factor to viewing information and information sources as credible. The flip side of

the small pool of fairly constant players is that personal and personality conflicts create breakdowns in the communication network that are as permanent as the people engaged in the conflict.

The relationship between message and messenger seems, in fact, to be quite complex, especially when the message (the information) is uncertain and/or its implications politically loaded – as is the case almost always with global change information. For such information to be heard and taken seriously, the information provider (producer, transmitter, or broker) must be trusted or at least offer credible scientific information and she or he must present it in an accessible manner. The interviews revealed several examples where available and certain but politically loaded information could only be made public with the added "protection" of scientific peer review, the credibility tool of science. On the other hand, non-scientific interviewees frequently wanted scientists to emerge from their ivory tower and to be more accessible to help people understand scientific (and frequently uncertain) information; perceived aloofness or "hiding" behind however solid science was seen as affecting people's openness to receive and struggle with scientific information.

Repeatedly, interviewees discussed the quality, format, and language in which such information was presented as critical – a point that relates back to the resource constraint issue discussed above: when people have little time and too many other things to juggle, the receptivity for big reports with complicated, dense, or inaccessibly written text with few graphics is very small. Interviews revealed that the means of communication first of all must motivate the receiver to engage with new and remote information. Other means than research reports were described as much more accessible, understandable, sought after, and hence more effective in conveying sea-level rise information: large colorful maps with some written scientific information) (as e.g., produced by the Maine Geological Survey); small information rich pocket-size flip charts (like that produced by the Laudholm Trust, (Wells National Estuarine Research Reserve 1997)); relatively short "citizen's guides" to coastal legislation and how it addresses SLR (like that produced by the Marine Law Institute (Marine Law Institute 1992)); videos; field trips; vivid slide presentations; and panel discussions (as produced by the University of Maine's Sea Grant office in the late 1980s and early 1990s or to be convened by the Laudholm trust on June 25, 1998).[42] These help to get people's attention and to point them to further information sources if needed or desired.

Hearing, understanding, and valuing information

Finally, there are a number of filters that affect which information is absorbed, which is passed on, and which is used in policy- and decision-making that emerged from my interviews. For example, people's lack of understanding of environmental processes versus the more limited human goals and political and economic time scales that commonly matter in policy- and decision-making emerged as an important factor in the screening and valuing of information. Obviously, the frequently mentioned political pressures and strategic assessments by various players what can, cannot, or should be said at any given time come into play here as well. Several interviewees mentioned that given the political pressures and the contentiousness of global change information, the institutional source of the information (researchers' affiliation, private versus public funding sources, etc.) mattered to them.

The frequency of hearing global change information, and hearing similar messages from a variety of sources also seems to have a bearing on whether or not information is retained, considered important enough to find its way into decision-making. The long-term efforts, for example, of state geologists Joe Kelley and Steve Dickson to educate governmental officials and the public at large, together with public education and outreach efforts by the MCP, Maine Audubon Society, the Wells National Estuarine Research Reserve, Sea Grant, and others, and the generous attention paid to coastal erosion (and even climate change) issues by the news media have created a presence of these matters in the public and governmental consciousness. In fact, to those removed from SLR (or any type) of research, the news media are frequently the first (and sometimes only) source of information on global change issues.

Information needs

Little complaint emerged from the interviews about the inappropriateness or unavailability of sea-level rise information, largely because SLR per se, especially accelerated SLR due to global warming was not people's major concern, but instead erosion and beach loss. Interviewees more often than not expressed a satisfaction with the access to information they had and the institutions and channels available to them through which to direct and have their information needs met. Interviewees at the local level appreciated the responsiveness and professionalism of state agencies with which their requests for technical information and, more frequently, for advice were met. While examples of less congenial relationships were reported as well, individual commitment to positive relationships and outcomes seemed to be a strong factor in making cross-scale communication and cooperation work.

Conclusions

The investigation of the cross-scale flow of information about sea-level rise and related hazards in Maine has yielded several important insights. First, Maine has a long history of scientific interest in local relative SLR. That is closely linked with an equally long history at the state governmental level of acknowledging the hazards associated with relative SLR and to use it as justification for coastal policies and programs. On that dual basis, the state has engaged in several efforts to investigate the impacts and response options to climate change and accelerated SLR. Coastal legislation to date, however, has been primarily driven by resource use conflicts and political considerations. Still, Maine used the threat of accelerated SLR as additional leverage to strengthen its efforts at coastal areas protection.

Because of severe erosion problems in the southern part of the state, local pressure has lead to establishing a number of fora for cross-scale, cross-constituency, cross-agency engagement and discussion to find new and mutually agreeable beach management strategies. Those will be regionally based and -- because of the networked design of the MCP -- involve officials from various levels of scale (municipalities, state agencies, and if appropriate federal agencies) and also representatives of local non-governmental groups who have a stake in beach preservation. The discussions among the involved parties were facilitated by independent outsiders and participants accounted a large part of the success of these deliberations to their sophisticated facilitation. The group meetings involved a significant educational component in which sea-level rise played a substantiating but not a driving role; this educational component continues currently through efforts to get Sea Grant funding for a community-based beach monitoring system where local citizens would be trained and equipped (and hence empowered) to measure

beach profiles (Kelley 1998). The group process also resulted in establishing new cooperative and information exchange links that seems to suit the beach management problem (i.e., the geo-ecological system) better; further, the process contributed substantially to building or deepening mutually respectful, understanding, and trusting relationships (Bernstein 1998; Dickson 1998; Ferdinand 1998; Kelley 1998; Lockman 1998; Roedner 1998; Van Cott 1998).

The question posed at the outset of this Appendix then, whether things in Maine are "the way they should be," really was a question about effectiveness – the effectiveness of information exchange systems and their impacts on policy-making, on the implementation of these policies through day to day decision-making, and on the outcome of this decision-making for public health and safety and the ecologically and economically sustainable use of coastal resources. Since many of the efforts currently underway in Maine are too new to say much at this time about the ultimate outcomes (not to speak of the lack of any quantitative data to measure outcome effectiveness), one can only draw conclusions about the effectiveness of the preceding steps in this sequence.

Information flow is not a continual or self-perpetuating process. It requires active initiation when a problem demands a particular kind of information or when someone finds it necessary to disseminate certain information. The interviews revealed that there is both demand and supply of information and that the exchange system established over time in Maine is quite stable (i.e., "nodes" in the information exchange network are well established and known), highly functional, and frequently and purposefully used. It is also increasingly constrained by diminishing resources (time, money, personnel). The efforts individuals make to overcome these constraints, for example by engaging in time consuming processes, educating themselves and each other, and helping each other out despite political pressures and struggles over authority (state-county-local), is remarkable.

While it is possible to say that some relationships in this information exchange and decision system could be improved, it would be difficult to argue in Maine that there are insufficient connections between the scientific and policy- or decision-maker community or between different decision-making agencies at different levels of scale. By my interviewees' own judgment, they were considered to mostly work effectively as well. Similarly, while more and more useful information especially for specific local areas are needed, there are continuous efforts within the academic and the applied science community in Maine to produce the kind of information needed to better respond to the management problems people have at the local level. The only connection seen as relevant between these state and local efforts on the one hand and global change science on the other may best be expressed in this concluding quote from state geologist and local SLR expert Joe Kelley:

> "Houses are too close to the water and <u>that</u> is the problem. That it would get worse with climate change -- sure, I agree completely, but I don't like to stake my positions on coastal development on a hypothetical change in climate. The present situation <u>demands</u> we examine the way we develop the coastline, and I don't need any future changes. It's already unbelievable. Sea level is rising in Maine <u>today</u> faster than it has in the last 4000 years. That it might double, I agree, it's terrible. It's catastrophic. But: if I make everything contingent on climate change, then I have to persuade my audience that that might happen.

And while you can do that, it's a long-winded argument when...it's an easy thing to persuade people that we got a problem now. ... And I say usually at the very end, '....oh, and here is the EPA projection for the future. It isn't likely to get better'" (Kelley 1998).

APPENDIX C: EXCERPTS FROM MAINE'S SAND DUNE RULES PERTAINING TO SEA-LEVEL RISE

Excerpts are taken from 38 MRSA §§ 471-478 (with the latest revisions from 1993) (Maine Revised Statutes Annotated 1993) as reprinted by the Department of Environmental Protection.

> Preamble: "Evidence exists that sea level is currently rising. In addition, theories have been developed which predict this rise to accelerate in the future. This rise will increase the rate of shoreline erosion and flooding, and the risk of damage to coastal property. ... The extent to which sea level will change in the future is uncertain. However, under any scenario of increasing sea level, the extensive development of sand dune areas and the construction of structures which are not practical to move increase the risk of harm, both to the sand dune system and to the structure."
>
> General provisions: "Projects shall not be permitted if, within 100 years, the project may reasonably be expected to be damaged as a result of shoreline changes. ... No building greater than 35 feet in height above existing grade, or covering a ground area greater than 2,500 square feet shall be constructed in a sand dune system unless the applicant demonstrates by clear and convincing evidence that the site will remain stable after allowing for a three foot rise in sea level over 100 years. Reliance upon an existing seawall shall not be sufficient as evidence of site stability. ..."

In an explanation added at the end of the rules, the following comments can be found:

> "A Preamble has been added to the Standards section which expresses the Board's[43] intent to limit the density, location and size of structures due to its concern for rising sea level. A number of commentators objected to an earlier version which stated "sea level is expected to rise at an accelerated rate in the future." The wording was subsequently revised to reflect that theories have been developed which predict an accelerated rise in sea level, but the amount which will occur remains uncertain. ..."

With regard to complaints about the requirement to demonstrate site stability under a three-foot rise scenario, the addendum continues,

> "Although the three foot figure for sea level rise is uncertain, a substantial amount of research has been conducted which supports a 3 foot rise, and the Board considers it appropriate given the more permanent nature of these [large] structures."

And finally,

> "Several people have commented that given the level of sea level rise, new restrictions should apply to the entire coast rather than just to the sand dune system. Consideration of areas outside the sand dune system, however, is beyond the legal scope of these rules."

These excerpts are cited at some length because they are unique in their explicitness with regard to accelerated SLR across the nation. Note also the open recognition of scientific uncertainty and how the Maine Board of Environmental Protection stands by the three feet figure anyway. Note also that the SDR codify a no-hardening rule (i.e., no new seawalls or other hard erosion control devices), prohibit any new buildings in high hazard flood zones, demand flood mitigation measures in 100 and 500-year flood zones (according to FEMA flood maps), and operationalize the most stringent retreat policy of any state in the nation by not allowing any structure to be rebuilt if it were damaged more than 50% in a storm unless the permittee can meet all rules and regulations pertaining to new structures. Finally, the SDR also regulate the reduction of development impacts on the dune system by requiring careful beach nourishment and restoration of beach vegetation. Despite several efforts (and successes) to weaken the SDR through legislative and court action, the law remains largely intact today.

APPENDIX D: HAWAI'I – MACZIMIZING INFORMATION EXCHANGE AND COLLABORATION?

In 1997, the world celebrated with Hawai'i the 40th anniversary of the Mauna Loa Observatory – the renowned institution on top of Hawai'i's highest volcano that has measured one of the most important scientific records of atmospheric change (most notably that of CO_2) and that was instrumental in launching global climate change science the world over. It epitomizes how the local production of scientific information can have global scientific and political ramifications. This appendix examines how these global scientific and political impacts have come back to Hawai'i and whether or not they have affected the state's coastal policy- and decision-making with regard to sea-level rise and associated hazards. The report of my findings in the 50th state of the U.S. is similarly structured to that of Maine. The first section below presents a brief overview of the Hawai'ian islands, their coastal resources, and vulnerabilities to SLR. The following section describes the legal basis and institutional structure for coastal zone management in Hawai'i. A selective summary of available state-specific scientific information on SLR and related hazards is given thereafter followed by a discussion of the extent to which coastal policies, decision-making, and other governmental activities to date consider SLR and climate change. Finally, I highlight the common themes that emerged in that portion of my research about information exchange and the integration of scientific information in coastal decision-making in Hawai'i and summarize the findings in the final section.

Island Geography and Hawai'i Coastal Resources

Global climate change and SLR concerns in Hawai'i must be viewed in the context of the very particular and challenging situation of islands. While mainland and islands may face SLR, inundation, or coastal floods associated with severe storms alike, the implications and management challenges for islands are arguably more difficult and possibly more severe. As participants of the recently held Regional Workshop on the Consequences of Climate Variability and Change on the Hawai'i-Pacific Region in Honolulu emphasized, there is a need to view these management challenges which island states like Hawai'i face from climate variability and change as distinct from those of continental areas (Public Health and Safety Working Group 1998, p.1). This does not necessarily contradict the statement made earlier that Maine and Hawai'i share a number of similarities which cannot account for differences in management effectiveness, because the external threats and some economic, demographic, and infrastructure features are very similar, but their implications for management are not. This highlights the importance and need to embed global change concerns within the local context. The particular challenges of island states -- to the extent that they relate to Hawai'i -- are cited here then to frame my discussion of SLR research, policy- and decision-making in this state.

The geography of the world's most isolated archipelago is characterized by a very small land area (with 6,423.4 square miles, it is smaller than Massachusetts) surrounded by the world's largest ocean, isolated from other Pacific island states, remote from the US and Asian mainland areas but extremely heterogeneous in its physical geography, ecology, climate, socioeconomic patterns, and culture (Maragos 1995). Hawai'i has a disproportionately high concentration of its population (90%), economic and industrial activity, political decision centers, and

infrastructure along the margins of its four biggest islands (Kaua'i, Oah'u, Hawai'i and Mau'i, with only a very small population on Moloka'i and Lana'i). This is underlined by the fact that 12% of Hawai'i's land area is too steep for development and about four fifth of the useable area is classified as agricultural (of which 75% are forest and grazing areas). The remaining land area is mostly in urban land use (Hawai'i/Office of the Governor/Office of State Planning 1990; Maragos 1995), using Atlas of Hawai'i 1983 figures). In addition, Hawai'i is exposed to a diverse and often violent set of natural hazards, many of which are climate-driven. The prevalence of hazards and the high exposure of human activity in the coastal zone make the state particularly vulnerable to coastal hazards and the impacts of SLR.

The tidally influenced coastline of Hawai'i is with 1,052 miles only about a third of that of Maine. Hawai'i, the Big Island, has the longest shoreline of all Hawai'ian islands, but only small stretches of beaches. Oah'u, the most heavily populated island with the state capital Honolulu, has the second longest shoreline and extensive beaches which form the backbone of the state principal industry since the 1970s: tourism (Hawai'i/Office of the Governor/Office of State Planning 1990). Finally, the oldest but least populated of the main islands, Kaua'i, and the second most important tourist destination, Mau'i, have shorter shorelines but similarly significant beaches (Hawai'i/DBEDT 1996). Coral reefs surround parts of the islands, and while they experience severe anthropogenic and periodic natural stresses (like during sea-level low stands in El Niño years like 1997-1998), they form an important ring of protection against storm or tidal waves and – as habitat for fish – a crucial natural resource base for the Hawai'ian fishing industry (Maragos and Payri 1997).

Hawai'i is rich in natural beauty and capable to support agriculture, horticulture, and forestry, but in comparison with mainland areas, its natural resources, especially fresh water, are limited. It is not self-sufficient in food crops. In addition, like other isolated islands, Hawai'i's ecology is highly vulnerable to disturbance and invasion. These factors should make Hawai'i even more concerned with the impacts of global climate change. Finally, there are a number of cultural and political characteristics that are important as the context to this study. Culturally, the state enjoys a great diversity in terms of languages, ethnicity's, and values. At the same time, Hawai'i has a relatively short but difficult political history with and within the US and despite the state's military, strategic importance to the mainland, Hawai'ians frequently bemoan their limited political clout, i.e., their limited ability to attract political attention and funding from distant mainland sources. More often, the greater regional proximity to other US affiliated and freely associated but independent states in the Pacific region leads to a stronger association than with continental US despite formalized political-institutional ties.

The Legal Basis and Institutional Structure of Coastal Zone Management

As an island state, coastal zone management is and has always been of great relevance to Hawai'i (Hawai'i Coastal Zone Management Program 1984; Hawai'i/DBEDT/Office of Planning/Coastal Zone Management Program 1997). Soon after the passing of the federal CZMA and the establishment of OCRM, Hawai'i (like Maine) began developing its own coastal zone management program between 1974 and 1977.[44] Originally housed within the Department of Planning and Economic Development, the program was designed through an elaborate interactive process between governmental staff, consultants, and the interested public, in particular the newly formed grassroots Shoreline Protection Alliance (Hawai'i/Office of the

Governor/Office of State Planning 1990; Cox 1998). A program review calls the result of this process "the most significant citizen participation program that the State has ever had" Alliance (Hawai'i/Office of the Governor/Office of State Planning 1990, p.4), yet another program review also acknowledges how difficult it is to encourage and make public participation work (Hawai'i Coastal Zone Management Program 1984, pp.18-19).

After several interim bills, the final Hawai'i Coastal Zone Management Act (HCZMA, also simply referred to as Chapter 205-A) (Hawai'i Revised Statutes 1977) was passed in 1977, and federally approved in 1978. It identified, like the Maine Coastal Program, a number of primary resource management areas and coastal hazards was one of them. The Act also designed a two-tiered institutional structure that divided management, oversight, and permitting responsibilities for different parts of the coastal system between the only two administrative levels that Hawai'i has – the state and the counties (Poirier 1998; Tom 1998; Walters 1998).[45]

Importantly, the HCZMP is based on managing and regulating particular zones along the coast (Challacombe 1998). These zones are overlain onto the four basic land use zones identified through the much older statewide zoning law (of 1962),[46] namely conservation, agricultural, rural, and urban areas. The state zoning law is implemented through county plans, zoning and subdivision ordinances, etc. and administered by county planning departments[47] (Arai 1998; Challacombe 1998; Hayashi 1998; Kalisik 1998; Suzuki 1998) but changes to the boundaries of the four basic zones can only occur through permission from the state's Land Use Commission (Jarman 1998). County park departments have coastal responsibilities with regard to county parks. While the entire state is considered "coastal zone," and thus falls in its entirety under Chapter 205-A, the politically most contentious authority is over the immediate shoreline areas, so-called Special Management Areas (or SMAs). These SMAs, at a minimum reaching 300 ft. inland from the shoreline, are regulated under home rule by the four counties, Kaua'i, Mau'i (which includes Molokai'i and Lana'i), Hawai'i, and the City and County of Honolulu (which basically equals Oah'u). In 1986, the HCZMP was amended by adding a shoreline setback provision (of at least 20-40 ft. from the shoreline) which are also administered by the counties. The state on the other hand has basic authority over conservation areas, and since all coastal waters fall into this zone, the state's authority extends seaward from the shoreline[48] and – if present -- includes much of the beach area (Lemmo 1998). **Figure 8** depicts how the administrative authorities at different levels of scale are spatially split across the coastal zone.

While the institutional set up of CZM in Maine has remained rather stable over the years, the HCZMP has been moved repeatedly around various state agencies. It enjoyed its greatest visibility for several years in the late 1980s when it was housed in the Governor's Office. The administration of Governor Cayetano has placed the Program for the last few years under the Office of Planning within the Department of Business, Economic Development and Tourism (DBEDT). After a recently abandoned legislative proposals to move it into the Department of Land and Natural Resources (DLNR), there are now discussions underway in the context of governmental streamlining of merging the coastal program with the Office of Environmental Quality Control within the Department of Health (DOH) (MACZMAG 1998b).

So, like in Maine, the Program administration is currently at home in a planning department while the bulk of the permitting authority lies with other state and county agencies. The regulatory power of the Office of Planning is confined to the federal consistency provisions of

the HCZMA. In contrast to Maine, however, some permitting authority lies also with agencies at another level of scale. The DLNR reviews permit applications for activities in the conservation areas. It is the primary agency involved in questions over beach management (Fletcher 1998; Lemmo 1998). The DLNR's Land Division also coordinates the Flood Plain Management Program, i.e., it administers the National Flood Insurance Program which, again, is implemented at the county level through flood ordinances and administered by county departments of public works (Hamnett and Davidson Oh 1996b; Kudo 1998; Young 1998). The DLNR also directs the Parks Program including the management of coastal state parks.

Several other state departments are involved in coastal zone management and permitting. The Department of Health implements state and federal environmental regulations like the Endangered Species Act or the Clean Water Act and is therefore involved in permit applications for dredging or wetland alteration. The Office of Environmental Quality Control, also housed in the DOH, is the principal agency reviewing and soliciting input into environmental impact assessments and statements (Miller 1998) which are an essential part of the permitting process in general, and for major projects in particular.[49] The Department of Marine Resources (DMR) and the Department of Transportation (DOT) are comparatively minor players in the context of shoreline development but significantly involved in other coastal management questions. The DOT is an important player in the context of coastal erosion control since it is responsible for maintaining state roads, many of which are in the immediate coastal zone. According to outside observers and various state officials, the DOT's preferred maintenance strategies frequently are opposed to the currently preferred beach management strategies, say, within DLNR.

Finally, the State Civil Defense is responsible for disaster response and as such another important player in coastal zone management, if not involved in the permitting or day-to-day management. Through its strong engagement in hazard mitigation efforts (e.g., as coordinator of the statewide Hazard Mitigation Task Force), however, its responsibilities go far beyond just emergency response (Price 1998).

Non-governmental players in coastal zone management fall basically into three groups: (1) researchers and academic institutions, (2) environmental NGOs; and (3) individual or organized private sector groups. Geologists, other Earth scientists, social scientists, and legal experts of the University of Hawai'i at Manoa (and the neighboring East-West Center (EWC), or the associated UH-Hilo and Mau'i Community College) as well as private engineering consultants form a tight knit network of scientists who get regularly involved in coastal management issues – either through proposals initiated by them or by being consulted by HCZMP staff (Fletcher 1998; Hamnett 1998; Jarman 1998; Lowry 1998; Maragos 1998; Miller 1998). Frequently, these researchers work in interdisciplinary teams in close cooperation with different state agency staff and with funding from HCZMP (see e.g., the recently completed Coastal Hazard Mitigation Project (Hamnett, Davidson Oh, et al. 1996) and follow-up efforts getting underway at present (Fletcher 1998; Hamnett 1998; Jarman 1998; Lowry 1998). In addition, the University's Environment Center – closely linked with the Office of Environmental Quality Control -- has established a unique system of drawing on a large, fast-acting pool of experts for the sophisticated and efficient review of permit applications and legislative proposals dealt with at the state governmental level (Miller 1998). The Environment Center also collaborates with the University of Hawai'i Sea Grant college which provides

cooperative extension services on a broad range of issues and with permanent offices on three of the four major islands (except Kaua'i) (Kumabe 1998; Mulane 1998a; Pfund 1998; Rappa 1998; Woolaway 1998). Sea Grant frequently provides either funding for, or is directly involved in, research projects conducted by university researchers; it also produces a number of educational materials and offers as part of its outreach efforts workshops on a variety of topics to state and county officials, teachers, and representatives of various ocean- or coast-dependent industries.[50] In past years, guided by directive and funding from the National Sea Grant Program, Hawai'i Sea Grant also gave workshops to teachers and local officials on a number of Pacific islands on global change, but no longer has the funding or staff to do so (Kumabe 1998; Miller 1998).

Among the environmental groups, the Hawai'i chapter of the Sierra Club is the most actively involved in coastal matters (Frankel 1998; Raney 1998). Several locally based environmental groups with stakes in beach preservation, The Nature Conservancy and several smaller land trusts are emerging as additional players, but their political presence is much less prominent so far. Native Hawai'ians who practice customary use rights of coastal land and water areas are also a politically significant group.[51]

Private sector players include the above mentioned consultants, but also planners, developers, and interested individuals. Several industries, including the tourism and recreation, fishing, and construction industries, bankers, realtors, and the insurance industry have major stakes in coastal politics and are involved if by no other means than their political economic power. The insurance industry is particularly interesting in Hawai'i since Hurricane Iniki in 1992 wrought havoc on Kaua'i and in the state's insurance sector. As a result of several cases of insolvency and retreat from the Hawai'ian insurance market, the state established the Hawai'i Hurricane Relief Fund (Hamnett and Davidson Oh 1996a; Hamnett and Davidson Oh 1996c; Hawai'i Hurricane Relief Fund 1997; Clawson 1998) to continue to provide coverage for residents and businesses.[52]

Again, as described for Maine, there are several direct links between local players and federal agencies. The federal government manages several wildlife refuges (bird sanctuaries and the Humpback Whale Sanctuary) and the Hawai'i Volcano National Park. Links to other major federal players in coastal zone management exist through the Ft. Shafter (Oah'u) offices of the US Army Corps of Engineers (Callies 1994; Boc 1998; Silva 1998) and the local office of FEMA for the administration of hazard mitigation grants (Kennard 1998). The local presence of the EPA is negligible with respect to coastal matters; instead, the major regional responsibility lies with EPA's Region IX office in San Francisco.

There are, if less so than in Maine, a few examples of collaborative efforts initiated under significant local, grassroots pressure to formulate regional (i.e., sub-county) coastal management plans – to date they are not concerned with erosion issues, but more frequently environmental health, watershed based management,[53] and resource use conflicts. One prominent example is the Kane'ohe Bay Master Plan Task Force that involved local residents of Kane'ohe Bay (Oah'u), environmental groups, representatives of local industries, and state and county representatives (Kane'ohe Bay Master Plan Task Force 1992; Maragos 1998). A coastal erosion management plan recently proposed by the DLNR (see below) suggests that there will be other sub-county coastal management units in the future, namely Coastal

Management Districts which are to address – with scientific, governmental, and local input -- beach erosion issues on a similar beach system basis as proposed in southern Maine (Hawai'i Board of Land and Natural Resources 1998).

Finally, the HCZMP has established a statewide forum – the Marine and Coastal Zone Management Advisory Group (MACZMAG) -- in which all of the different stakeholders can regularly come together (about once every two months) either in their capacity as agency representatives (regular members), as consulting resource individuals, or simply as members of the interested public who wish to express their views on coastal management issues. Several of my interviewees considered the establishment of MACZMAG an important step toward improving cross-agency, cross-scale, and cross-constituency information exchange while others were more skeptical whether this large meeting could really accomplish that and whether it could produce any discernible changes in the effectiveness and outcomes of coastal zone management. MACZMAG has formed several sub-committees in which (according to one member) "we're really getting things done." One of these sub-committees deals exclusively with coastal erosion management questions and in particular with the problem of how to streamline the very time-consuming, multi-agency (federal-, state-, and county-level) permitting process for beach nourishment (Challacombe 1998; Lemmo 1998; Walters 1998; MACZMAG 1998a; MACZMAG 1998b). The work of the sub-committee is closely tied to the coastal research undertaken by UH geologist Chip Fletcher (see below).

During the concerned discussion among MACZMAG members of the proposed merger of the HCZMP with the Office of Environmental Quality Control, June Harrigan-Lum (DOH) stated that "it's long been known that we need to better manage the connection between the UH [University of Hawai'i] science contingent and the policy/management contingent in order to maximize information exchange. It doesn't matter where the CZMP is located as long as the information management is improved." Whether her proposal to set up a MACZMAG sub-committee to deal with these information management issues will be implemented remains to be seen. That such a committee was even proposed, however, confirms the sense that emerged overall from the Hawai'i interviews that while an elaborate, multi-agency, multi-scale system is set up for coastal zone management, and while the intentions and goals of the Program as a whole and of individual officials are exemplary, there are significant communication and implementation gaps that create inefficiencies, delays, frustration, and ultimately unachieved coastal management goals.

State-Specific Sea-Level Rise Research to Date

Geological sea-level rise research has been somewhat of a stepchild of geology on Hawai'i in the face of the overriding interest in active hot spot volcanism (Fletcher 1998). Nonetheless, SLR research on the islands dates back to at least the late 1940s and has been pursued much with the motivation to reconstruct the contested Holocene sea-level history of the Pacific Basin (Jones 1998; Nunn 1998). It is important to highlight a few findings of that research as they have direct implications for modern-time beach management. Relying on coral reef chronology, geomorphology, and coastal geology, researchers have accumulated increasing evidence that sea level in the Pacific was at a highstand (about 3 ft. higher than present MSL in Hawai'i) during the mid-Holocene, i.e., about 4000-5000 years BP (Fletcher and Jones 1996; Coastal Geology Group 1997b; Jones 1998; Nunn 1998). "Low lying coastal plains, sand

resources, dune evolution, and coastal wetlands all owe their existence, in part, to a relative fall of sea level over the last c. 5000 yr. This episode in sea-level history, now apparently ended, is the result of both local-scale and global-scale processes related to local tectonics and geophysical responses to the deterioration of the last great ice sheet" (Coastal Geology Group 1997b) (**see Figures 5 and 6**).

The importance of this geological history for young islands that have not yet had enough time to weather much of their volcanic parent material into loose sediment is that the sand reserves that predominantly feed their beaches are located slightly inland from the present coastline. As sea level rises due to local subsidence and global eustatic sea-level change now and in the future (**Figure 7**), the encroaching sea will erode (remobilize) these older deposits and – if left unencumbered – be able to maintain, if further inland, the net width of the islands' beaches (Fletcher 1998). On the other hand, any human attempt to maintain the current shoreline in place through hardening interferes with these natural coastal dynamics and starves the beaches of their land based sand reserves.[54]

Since the early 1990s, with the arrival of coastal geologist Charles (Chip) Fletcher at the University of Hawai'i at Manoa, geological research on the reconstruction of the Holocene sea-level rise record has become more applied in flavor. A large portion of Fletcher's and his Coastal Geology Group's work focuses on shoreline change, erosion rates, and beach loss with the intention "to make this knowledge available to governmental planners, decision makers and the public to better manage the coastal zone and ensure sustainability for future generations" (Coastal Geology Group 1997a).[55] Much applied coastal research on beach dynamics is also undertaken outside academia by a very active coastal engineering community. According to an estimate by Chip Fletcher (1998), engineering consultants receive about $30,000-100,000 annually from the Hawai'i Coastal Zone Management Program (HCZMP), and several times that amount from counties, to study the impacts of projects on a site by site basis. There is, however, no strategic approach to these studies nor any integration of them into a review of beach management strategies.

In an attempt to establish a "scientific basis for evaluating current land management practices" in Hawai'i (Fletcher, Mullane et al. 1997, p.209), the Coastal Geology Group at the University of Hawai'i has studied the implications of relative sea-level rise and sediment deficiencies in terms of beach erosion and beach narrowing and loss for Oah'u and is undertaking similar studies for neighboring islands. Their work is based on larger shoreline change studies conducted previously by applied researchers including shoreline change studies for Oahu (Hwang 1981; Sea Engineering Inc. 1988) and for other islands (Makai Ocean Engineering Inc. and Sea Engineering Inc. 1992). Despite these efforts, there is still "a big dearth of scientific information on sediment transport," according to one user, Honolulu city and county planner Art Challacombe (Challacombe 1998). The situation is slowing improving, however, with the continuing work by Fletcher and colleagues and his training of coastal geologists.

Besides the significant long-term SLR and applied beach erosion research underway in Hawai'i, it is important to point to the shorter-term sea level variations over a variety of time scales and of varying magnitudes (**Table 2**) that Hawai'i experiences. These sea-level changes are frequently larger, shorter in on-set and duration, and thus more visible and to some observers of greater concern than the long-term changes expected with climatic change.

These short-term SL variations can significantly affect coral reefs, coastal aquifers, ocean and coastal recreation, and public health and safety and thus attract generally more attention, especially by coastal managers and the public at large than the slow process of eustatic or relative SLR (Lukas 1998).[56] At present, for example, the Pacific region experiences the most severe El Niño in recorded history and is more concerned with drought, sea-level *fall* and its impacts on coral reefs, and the potential for more frequent or intense tropical storms later in the season than with the longer-term trends.[57] Thus, quite similar to his far-away colleagues and acquaintances in Maine, Joe Kelley and Dan Belknap, Fletcher focuses his work strategically on the more immediate, locally visible shore erosion problems rather than on SLR per se, though like his colleagues in Maine he also uses continuing and potentially accelerating SLR as an additional argument in support of changing beach management practices, including a long-term retreat from severely eroding oceanfront (Challacombe 1998; Fletcher 1998; Lemmo 1998); see also (Fletcher and Hwang 1992; Fletcher, Mullane et al. 1997; Hawai'i Board of Land and Natural Resources 1998).

Sea-Level Rise Policies and Decision-Making to Date

The telling of Hawai'i's policy-making and decision-making activity with regard to sea-level rise and global change is much briefer than that of Maine's. In short, Hawai'i has not formulated any policy to respond to these global threats. This is not to say that global change has gone unnoticed in governmental circles or has never been subject of governmental reports. Most deliberately, in 1985, responding to a state senate resolution (Resolution 137, 1984), the Hawai'i Coastal Zone Management Program produced a short report on the potential "effects of a worldwide rise in sea-level induced by the 'greenhouse effect'" (Hawai'i Coastal Zone Management Program 1985). This report – entirely qualitative and typical for that time in its simple approach to the assessment – projected rather dire consequences for four different SLR scenarios for Honolulu. It included several maps indicating the position of the shoreline for each of the scenarios (1.9, 4.8, 7.1, and 11.3 ft. respectively) and described for each the (dys)functionality of coastal infrastructure. While with today's scientific projections of SLR over the next 100 years these scenarios seem exaggerated, the projected impacts – especially for the second, third, and fourth scenario -- were alarming, if not outright catastrophic, and should have – given its focus on the political and economic center of Hawai'i -- produced loud outcries among the intended audience. Several critical shorefront installations were projected to be inundated under those SLR scenarios, including the Honolulu International Airport, major traffic arteries, and significant high-value property in Honolulu's tourist center Waikiki. One non-governmental but well-informed insider explained that for acute political reasons this report never received any publicity. It is even questionable whether it even reached its destination or was publicly discussed in the state senate at all.

So while no governmental response followed the preparation of this SLR assessment report, it contained several recommendations (Hawai'i Coastal Zone Management Program 1985, pp.7-8), including:

- to continue studying SLR and its impacts on Hawai'i and to revisit the issue of SLR in 1989; and

- to develop a more comprehensive and detailed plan at that time which would indicate how SLR could be addressed within planning, shoreline infrastructure development, the stricter implementation of existing regulations, and through economic incentives to facilitate development away from hazardous areas.

According to HCZMP Director Doug Tom (Tom 1998) and the Director of the Social Science Research Institute (UH), Mike Hamnett (Hamnett 1998), the issue has not been revisited since and follow up is not expected in the near future. While SLR may not have been taken up again by the Hawai'i state legislature, the HCZMP has financially supported the preparation of the Beach Management Plan with Beach Management Districts by coastal geologist Chip Fletcher and environmental lawyer Dennis Hwang (Fletcher and Hwang 1992). The report – in excerpts also submitted as testimony to the US Senate Energy Committee -- discusses at length the current and projected future rates of sea-level rise for each of the major Hawai'ian islands, taking island subsidence and global accelerated sea-level rise projections by the IPCC into account and assesses available management options for the HCZMP.

Sea-level rise has also surfaced occasionally in other state governmental publications, including in the Hawai'i Ocean Resources Management Plan (Hawai'i Ocean and Marine Resources Council 1991a, pp.61-62, p.71); (Hawai'i Ocean and Marine Resources Council 1991b, pp.30-31) (policy recommendation J states: "plan for climate change, sea-level rise, and emerging issues" and "track scientific research on global change and sea-level rise"). Hazard management specialist Jeff Walters of the HCZM office, who oversees the re-assessment of the state of implementation of the ORMP currently underway, confirmed that there is no specific policy action on behalf of sea-level rise. Ongoing relative sea-level rise also gets brief mention in a recently published leaflet on coastal erosion and beach loss problems in Hawai'i (Hawai'i/DLNR 1998), in the newly developed Coastal Erosion Management Plan (COEMAP (Hawai'i Board of Land and Natural Resources 1998), and in the Beach Management Plan for Maui (University of Hawai'i Sea Grant Extension Service and County of Maui Planning Department 1997), but climate change is not explicitly mentioned as a justification. On the other hand and rather unsurprisingly, sea-level rise and other consequences of global climate change were mentioned as part of the federally (EPA) funded Hawai'i Greenhouse Gas Inventory study completed by the state's Department of Business, Economic Development, and Tourism (State of Hawai'i 1997). Interestingly enough, SLR or climate change did not play any role in two related and recently completed hazard mitigation studies, one conducted by the (U.S. Army Corps of Engineers 1997) focusing on the large number of energy and lifeline facilities in the coastal flood zone, and the another done by the (U.S. Department of Energy - Office of Emergency Management 1996) focused on Hawai'i's energy industry.

In the most recent past, governmental officials have attended climate change conferences that addressed the issue of SLR, namely a workshop on Climate Change Implications and Adaptation Strategies for the Indo-Pacific Island Nations, held in September 1995 at the East-West Center and co-sponsored by the Sea Grant Program (Rappa, Tomlinson et al. 1995), and they were more heavily involved (from the Governor's office to the departmental staff level) – both in attendance and organization – in the Regional Workshop on the Consequences of Climate Variability and Change that was part of the National Assessment. And finally, the Hawai'i CZMP co-sponsored the First Regional Conference on Coastal Erosion Management

in Hawai'i and Other Pacific Islands held on Mau'i in April 1998 which dealt among other things with sea-level rise, and which was attended by several state and county-level government employees (University of Hawai'i/Sea Grant 1998).

In short, various state agencies have been involved in studies that mention global climate change and its implications for sea-level rise. There is no indication, however, that they have informed any specific policy- or rule-making, an observation confirmed by all Hawai'ian interviews. In fact, the only time to date where SLR scientific information (via the CZMP report for the state senate) had a clear opportunity to reach a legislative, policy- and rule-making body, that opportunity was passed up and has not been taken up again since. The emerging strong focus on beach erosion, beach loss, and replenishment and accompanying publications and public outreach have brought the documented ongoing relative SLR to public and policy-maker attention (Fletcher 1998; Hawai'i Board of Land and Natural Resources 1998; Lemmo 1998; Walters 1998), however, without any emphasis on future trends.

Information Exchange and Decision-Making

The common themes identified for Maine in Appendix B regarding what affects information up-take, processing, sharing, and integration into decision-making were echoed across the board in Hawai'i. Some were more pronounced – for example the issue of resource constraints; other previously identified themes had some distinct Hawai'ian features and I will discuss them in more detail below. Some of the striking additional issues that arose specifically from this case study, however, relate to the issues of cross-scale and interagency cooperation and implementation of coastal policies, and they will be the principal focus below.

Tight belts, undervalued coastal resources

In almost all interviews, interviewees framed some portion of their interaction with coastal zone management actors in the context of the current fiscal and economic crisis of the state. Hawai'i has -- on the heels of the US economic recession of several years ago and especially the economic crisis in Japan and Asia -- experienced a state-wide, all-sector economic recession for more than eight years. As a result, state allocation of funds for coastal research projects or beach management schemes has been much reduced. In addition, staff positions have been cut, programs are being merged, and state and county/city agencies re-structured in order to streamline and downsize government. So while everyone spoke of the need to set priorities because of the limited resources, more than once officials admitted that they could not follow through even on program priorities to the extent that they wished or are required to because they had too many responsibilities to juggle.

This phase of tight belts (not only) for coastal zone management must be seen, however, in the context of a larger concern raised by a number of non-governmental observers, namely the lack of sustained political support for coastal zone management at all levels of government. Since its inception, the HCZMP has undergone at least four phases of restructuring or relocation within state government, indicative of the political motivations underlying these moves. This again, as several interviewees pointed out, needs to be seen against the backdrop of a general lack of understanding among elected officials and the public at large of coastal processes and of how the physical coastal environment is at the base of the Hawai'ian economy and culture. One interviewee – in reflecting on the history of the HCZMP -- captured the situation

expressed by many others: "the Hawai'i CZMP has matured into obscurity." The relatively recent appointment of a sincere and politically savvy individual (Mike Wilson) as head of the DLNR who is also committed to improved coastal zone management and who is concerned about global environmental change, is hence very significant. Moreover, the need for additional, and the significance of ongoing, educational and outreach efforts to inform the general public, governmental officials, the state legislature, and industry representatives by the University of Hawai'i through its Sea Grant extension service, through individuals like Chip Fletcher and Mike Hamnett, or efforts by DLNR's Sam Lemmo, Vice Director of the state's Civil Defense, Roy Price, and others can thus not be overestimated.

Hawai'i-mainland/federal tensions

Not only in times of economic crisis, but in particular during such times, states look to the federal government for support. Such requests can only be adequately understood in the historical and geographical context of the frequently tense relationship between Hawai'i and the US mainland and Hawai'i and the federal government which emerged frequently in the interviews. Federal agencies, unless they are locally based and staffed by local residents ("local feds"), and US mainlanders are commonly and skeptically viewed as outsiders. Historically, many Hawai'ians see themselves as having been forced into the federal union, and since then many perceive their state as being "forgotten" by the federal government. Far away from the political centers of the US, much attention of the HCZMP is focused on getting federal financial support at the same time that it tries to shield the state and counties from federal interference in coastal affairs. This political, historical context frames most federal-state interaction and requires – as interviewees pointed out -- that communication and cooperative relationships must be built carefully, patiently, and with a great deal of respect and humbleness on the part of federal representatives and other outsiders.

Comparative advantages of personal and institutional involvement

When coastal zone management involves as many players at several levels of scale as it does in Hawai'i (and even more in other states), questions of comparative advantage and the value of strategic decisions over the involvement of particular individuals or institutions arise. During this research, two seemingly contradictory approaches emerged, each with its own set of trade-offs: (1) to *broaden* the involvement of actors from agencies, academia, and the public to create more support and understanding for difficult CZM policies and decisions, and (2) to strategically *reduce* the number of players and – as one framed it -- to "use the right tools and people for the right job." Several examples I was told lead to the conclusion that when a new project or approach is launched – especially ones that are likely to encounter political, financial, legal, or technical hurdles – it may be more effective to do it with people and institutions "where the skill level and enthusiasm is high" (Shea 1998a). One may suspect that a combination of both approaches may work best over the long-run, but that requires long-range, comprehensive planning and a flexible adaptation in the approach to information sharing at various stages in the process.

Turf and trust

The issue of agency missions and professional goals and progress discussed previously for Maine, reemerged strongly in Hawai'i. There appear to be two sides to it that clearly affect information flow and cooperation, namely <u>contradictions</u> in agency missions or approaches and <u>competition</u> in cases of overlapping jurisdiction, authority, or expertise (i.e., turf issues). One

example for the former was given above: the contradictory approaches of DLNR and DOT to beach management. While DLNR increasingly favors and works toward no-hardening rules, beach nourishment, and long-term strategic relocation away from high-hazard areas, the DOT prefers hardened shorelines to protect coastal infrastructures (e.g., roads) in place because beaches create additional maintenance problems. Both argue that over the long-term their preferred strategy is the more cost effective one. Another example is a competition across scale: counties regulating the Special Management Areas, setbacks, and floodplain areas are required to assure public safety and they have a strong economic interest in expanding their tax base, i.e., to encourage and allow development at the lucrative oceanfront. The DLNR, on the other hand, is charged with preserving and extending the public good of beaches and access to them. Where coastlines experience long-term erosion trends, there is a clear conflict in goals even if both authorities adequately adhere to the rules and regulations they each administer.

This is precisely where competing missions turn into turf issues, especially in the struggle over state or local (county) authority. Another turf example relates to the need to be able to claim ownership for accomplishing a particular goal or for the completion of a project. Interviewees related several instances where they felt one had claimed ownership for something another had put more effort in. There are also turf issues regarding the importance of different types of knowledge, e.g., Native knowledge versus lay knowledge versus scientific expertise overlain by the Hawai'ian versus outsider dichotomy. Depending on individual personalities, such competition and turf issues can take on a very personal side and affect the willingness to share information and to work with each other. On the other hand, there were also – in the best "aloha spirit" -- examples of the opposite case where individuals in different agencies and positions banked on their similar experiences and common goals to build very strong and congenial relationships, met personally and exchanged information on a regular, frequent basis.

Implementation

As described above the HCZMA and the more recent Hawai'i Ocean Resources Management Plan aspire to the best coastal zone management goals and an integrated coastal zone management scheme. The ongoing activities of the Program have produced an impressive stack of studies to improve CZM in Hawai'i and yet, many interviewees complained about the lack of follow through and implementation in policy or regulatory terms. The resulting frustration has lead some to try out new approaches: one is the concerted and committed effort lead extra-governmentally by Chip Fletcher and from within the government by the DLNR (Mike Wilson as the political head, Sam Lemmo at the staff level) to build a constituency "neighborhood association by neighborhood association" for alternative approaches to beach management (see above). Another – and related to the first – is to conduct a comprehensive study of a select few test cases where alternative beach management approaches are actually implemented – in other words, an adaptive assessment and management approach. In Hawai'i, interviewees at the state and county level, in- and outside of government reiterated that the tried and tired one-directional top-down approach to implementation will not work, because it continues to run into home rule resistance, ignorance, and a general lack of political support.

Credibility and reputation

Clearly, interviewees regarded the input from scientists as essential, and this research demonstrated that there is no lack of scientific activity in support of coastal zone management. The commitment of scientists to the production of high-quality and useful information,

however, was only one aspect of building their credibility. Equally important was their non-patronizing willingness to work directly with communities and governmental agencies, to hear people's (especially coastal residents') concerns and to follow-through with plans and commitments. Citizens and officials have high expectations of scientists to secure funding for new projects when scientists become advocates for alternative ways of doing things. Securing resources thus seems to play an important role in establishing and maintaining credibility and the reputation of projects and programs.

Conclusions

The preceding sections have shown the Hawai'i faces a number of difficult odds in coastal zone management: a historically challenging relationship between the state and the federal government; continuing struggles between the state and the counties over coastal zone management authority; a severe and persistent economic crisis; its geographic isolation; and its increasing vulnerability to relative and accelerated SLR, tropical storms, and other climate-driven natural hazards. On the other hand, Hawai'i has an alive and engaged scientific community, a dense network of cross-agency, cross-scale relationships, and an elaborate but less stringent set of policies than that of Maine to guide coastal management. While most interviewees from all positions in that network appreciated the already achieved improvements in information exchange and collaboration, they also wished for yet better communication and more technical information specifically geared toward their respective responsibilities. They also all bemoaned the "politics that get in the way" of implementing the Program goals.

To the extent that the HCZMP associates itself with, and actively contributes to, the above described alternative attempts to build constituencies and to manage its coastal/beach resources – either by providing funding and personnel time or by contributing through education and outreach -- its visibility in the state and in the legislature is likely to grow. Thus, as the state enters a new phase of coastal zone management, the reputation of the Program is closely tied to the success of these applied scientific efforts, suggesting that as the stakes for the Program rise, its commitment in support of these budding projects – if for no other reason than self-preservation -- needs to increase as well.

APPENDIX E: LIST OF INTERVIEWEES AND MAJOR INFORMANTS

National/Federal (9)

Brower, David. Professor of Urban and Regional Planning. Center for City and Regional Planning, University of North Carolina, Chapel Hill, NC.

Coppock, Rob. Senior Research Fellow. German American Academic Council (formerly with the National Research Council), Washington, DC.

Davidson, Margaret. Executive Director, NOAA Coastal Services Center, Charleston, SC.

Godschalk, David. Professor of Urban and Regional Planning, Center for City and Regional Planning, University of North Carolina, Chapel Hill, NC.

Lecomte, Eugene. Executive Director Emeritus of the (formerly) Insurance Institute of Property Loss Reduction, now Institute for Home and Building Safety, Boston, MA.

Pilkey, Orrin. Professor of Geology, Program for the Study of Developed Shorelines, Duke University, Durham, NC.

Shea, Eileen. Executive Director of the Center for the Application of Research on the Environment (CARE), Calverton, MD.

Titus, James. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC.

Zinn, Jefferey. Congressional Research Service (formerly Executive Director of the Coastal Society), Washington, DC.

Maine (32)

Adams, Vicky. Outreach Director, Laudholm Trust, Wells National Estuarine Research Reserve. Wells, ME.

Albert, Kathryn. Coastal Coordinator, Southern Maine Regional Planning Commission. Sanford, ME.

Anderson, Donald. Environmental Specialist. Department of Environmental Protection. Augusta, ME.

Bailey, Elisa. Administrative Director, Georges River Land Trust. Rockland, ME.

Beard, Ronald. Extension Educator, University of Maine, Cooperative Extension and Sea Grant College. Orland, ME.

Belknapp, Daniel. Professor of Geology. University of Maine. Orono, ME.

Bernstein, Judy. Town Planner. Kennebunk, ME.

Colgan, Charles. Professor of Public Policy and Management. University of Southern Maine, School of Law. Portland, ME.

Connors, James. Senior Project Planning Coordinator. Maine State Planning Office. Augusta, ME.

Cost, Jennifer. Staff Attorney. Maine Audubon Society. Falmouth, ME.

DesMeules, Mark. Manager. Land for Maine's Future Program, Maine State Planning Office. Augusta, ME.

Dest, Paul. Communications Director. Maine State Planning Office. Augusta, ME.

Dickson, Stephen. State Geologist. Department of Conservation, Maine Geological Survey. Augusta, ME.

Dickstein, Carla. Senior Program Officer. Coastal Enterprises, Inc. Wiscasset, ME.

Dionne, Michelle. Research Coordinator. Wells national Estuarine Research Reserve. Wells, ME.

Ferdinand, Bill. Planner and law specialist. Formerly with the Maine State Planning Office. Augusta, ME.

Gagnon, Barbara. (Interim) Assistant Code Enforcement Officer, Town of Wells. Wells, ME.

Hamilton, Christopher. Communications Director. Maine Coast Heritage Trust. Brunswick, ME.

Kelley, Joseph. State Geologist. Department of Conservation, Maine Geological Survey. Augusta, ME.

Lockman, J.T. Director of Planning and Development, Town of Wells. Wells, ME.

Madore, Jeff. Department of Environmental Protection. Augusta, ME.

Maloney, Judy. Senior Planner. Maine Emergency Management Agency (MEMA). Augusta, ME.

Martucci, David. Executive Director, Mid-Coast Regional Planning Commission. Rockland, ME.

Naegel, Annette. Director of Science and Stewardship, Island Institute. Rockland, ME.

Platt, David. Publications Director, Island Institute. Rockland, ME.

Roedner, Richard. City Planner, City of Saco. Saco, ME.

Rudoff, Fran. Director, Coastal Program, Maine State Planning Office. Augusta, ME.

Sidell, Lou. Coordinator, Floodplain Management Program, Maine State Planning Office. Augusta, ME.

Todd, Fred. Manager of Planning and Administration, Land Use Regulation Commission (LURC), Department of Conservation. Augusta, ME.

Della Valle, Beth. Planner, Community Assistance Program, Maine State Planning Office. Augusta, ME.

Van Cott, Paul. Director, Southern Maine Regional Office of the Department of Environmental Protection. Portland, ME.

Vestal, Barbara. Assistant Director, Marine law Institute, University of Southern Maine, School of Law. Portland, ME.

Hawai'i (33)

Arai, Daryn S. Planner, Hawaii County Planning Department. Hilo (Hawai'i), HI.

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Cappelle, Claire. Public Education Coordinator, Hawai'i Coastal Zone Management Program, DBEDT. Honolulu (Oah'u), HI.

Challacombe, Arthur. Chief, Environmental Review Branch, City and County of Honolulu, Department of Land Utilization. Honolulu, HI.

Clawson, Scott. Market Specialist, Hawaii Hurricane Relief Fund. Honolulu, HI.

Cox, Richard. Commission member, engineer, Commission on Water Resource Management. Honolulu, HI.

Fletcher, Charles (Chip). Professor of Geology. University of Hawai'i. Kailua (Oah'u), HI.

Frankel, David. Executive Director, Sierra Club-Hawai'i Chapter. Honolulu, HI.

Hamnett, Mike. Driector, Social Science Research Institute, University of Hawai'i. Honolulu, HI.

Hayashi, Norman K. Planning Program Manager, Hawai'i County Planning Department. Hilo, HI.

Jarman, Casey. Associate Professor of Law, W.S. Richardson School of Law, University of Hawai'i. Honolulu, HI.

Kalisik, George. County Planner, Kaua'i County Planning Department. Lihue (Kaua'i), HI.

Kennard, David. Hazard Mitigation Specialist, Federal Emergency Management Agency. Ft. Shafter, HI.

Kudo, Wallace. Civil Engineer V, County of Kauai, Department of Public Works, Division of Engineering. Lihue, HI.

Kumabe, Elizabeth. Extension Agent, University of Hawaii, Sea Grant. Honolulu, HI.

Lemmo, Sam. Planner. Department of Land and Natural Resources, Land Division, Planning Branch, Honolulu, HI.

Lowry, Kem. Professor of Urban and Regional Planning, University of Hawai'i. Honolulu, HI.

Maragos, James. Senior Fellow, Program on Environment, East-West Center. Honolulu, HI.

Miller, Bruce. Director of Extension, Sea Grant. University of Hawai'i. Honolulu, HI.

Miller, Jacqueline. Associate Director, Environmental Center, University of Hawai'i. Honolulu, HI.

Mulane, Rob. Extension Agent, Hawai'i Sea Grant, Maui Community College. Kahului (Mau'i), HI.

Pfund, Rose. Director, Sea Grant, University of Hawai'i. Honolulu, HI.

Poirier, Richard. Planning Program Manager, Hawai'i Coastal Zone Management Program, DBEDT. Honolulu, HI.

Price, Roy. Vice Director of Civil Defense, State of Hawaii, Civil Defense Division. Honolulu, HI.

Raney, David. Member and Past Chapter Chair and Regional Vice-President, Sierra Club-Hawaii Chapter. Honolulu, HI.

Rappa, Peter. Extension Agent, Sea Grant. University of Hawai'i. Honolulu, HI.

Shea, Eileen. Executive Director of the Center for the Application of Research on the Environment (CARE), Calverton, MD; also Coordinator of the Regional Workshop on the Consequences of Climate Variability and Change for the Hawai'i-Pacific Region.

Silva, Lolly. U.S. Army Corps of Engineers. Ft. Shafter, HI.

Suzuki, Daren. Senior Planner, Mau'i County Planning Department. Wailuku (Mau'i), HI.

Tom, Doug. Director, Coastal Zone Management Program, DBEDT. Honolulu, HI.

Walters, Jeff. Planning and Policy Analyst, Hawai'i Coastal Zone Management Program, DBEDT. Honolulu, HI.

Woolaway, Chris. Extension Agent, Sea Grant, University of Hawai'i. Honolulu, HI.

Young, Sterling. Coordinator, Floodplain Management Program, DLNR. Honolulu, HI.

ENDNOTES

[1] I would like to express my deep gratitude to all of my interviewees and informants, for their generosity with time and information, and for their hospitality in making my research enjoyable and beneficial at once. I am grateful to my old and new friends who hosted me on my travels. And thank you also to Eileen Shea, David Cash, William Easterling, Tom Wilbanks, William Clark, and Sheila Jasanoff for supporting and accompanying this research and for their comments on earlier drafts of this paper. They have greatly improved its structure and content and initiated new thinking on cross-boundary information flow. Finally, I would like to acknowledge the participants of the Scale Working Group during the Summer Study at Bar Harbor, ME (June 17-14, 1998), for constructive criticism and wonderfully stimulating discussions and insights.

[2] Thirty-three interviews were conducted in Hawai'i with federal, state, and county-level governmental officials (staff to program director levels) involved in coastal zone and hazard management, researchers at the University of Hawai'i, including sea Grant extension agents, at the East-West Center, and with representatives of environmental NGOs. Thirty-two interviews were conducted in Maine with federal, state, county, and municipal-level governmental officials (staff to program director levels) involved in coastal zone and hazard management, researchers from the University of Maine in Orono, including Sea Grant extension agents, the University of Southern Maine in Portland, from the National Estuarine Research Reserve in Wells, and with representatives of environmental NGOs. I was unable to interview elected officials concerned with coastal matters as both state legislatures were in session during the field season and legislators unavailable for interviews. Because of time constraints, no interviews were conducted in Washington, DC, however, five of the above-mentioned interviewees are also active in national organizations and federal institutions. Supplementary evidence was drawn from 9 interviews conducted between 1996 and 1997 with federal agency staff, with representatives from the Institute for Insurance Property Loss Reduction (IIPLR, now the Institute for Business and Home Safety, IBHS), and with nationally renowned coastal scientists. Those interviews informed a related study that dealt at least in part with the interactions between science and policy in the context of US policy responses to sea-level rise. That research was supported through a dissertation award (SBER 95-11045) from the National Science Foundation's Decision, Risk and Management Science and Human Dimensions of Global Change Programs. The data, findings, and opinions drawn from that research should not be attributed in any way to the NSF or any other federal agency and the responsibility for any conclusions, mistakes, and omissions rests with me.

[3] For a detailed interview protocol see Moser and Cash (1998). The interview questions may not have been asked in exactly the order or wording prescribed in the interview protocol in order to accommodate the flow of conversation. The average length of interviews was just above one hour, ranging from half an hour to two hours. About a half dozen of the interviews were short and incomplete, i.e., they covered only selected issues of information exchange and decision-making, for example, to obtain more detailed background on a particular study or information/education campaign.

[4] I determined whether, and how, these assessments, studies, and educational outreach campaigns have actually affected decision-makers, i.e., in what ways they have informed decisions. The intended and actual use of this type of information was investigated through a search of public statements (e.g., in legal

findings, reports, the media, and so on) and through detailed structured interviews with key informants. These interviews were intended to provide the deeper empirical understanding of information sharing, communication, and cooperation for a better integration of scientific information and policy- and decision-making. In particular, the interviews tried to establish – from the perspectives of the users of information - - what types of information decision-makers need, which sources they turn to, and why certain sources are preferred to others. Interviewees in each state and at the federal level were selected through an iterative process and from a variety of sources, including prior contacts at the federal and state levels who provided further contacts, internet sites (institutional websites), scientific publications, and Coastlinks - a directory of Maine coastal organizations. Additional information and contacts for Hawai'i were obtained at the *"Workshop on the Consequences of Climate Variability and Change for the Hawaii-Pacific Region"*, held March 2-6, 1998 in Honolulu and at a public advisory committee (MACZMAG) meeting. At the national level, information was also gathered while participating at *"U.S. Climate Forum" on the consequences of global change for the nation*, held November 12-13, 1997 in Washington, DC and through continued access to information on the U.S. National Assessment process through established contacts.

[5] In Hawai'i this theme was particularly prevalent due to the persistent fiscal and economic crisis of the state over the past eight years that developed on the heels of the US economic recession of several years ago and especially the economic crisis in Japan and Asia.

[6] The resource constraints also affect policy- and decision-making in that they restrict the issues any level of government will and can deal with fiscally. Implementation of SLR adaptation measures costs money and communities will have to make trade-offs between say, expanding schools, buying new fire trucks, repairing roads, or nourishing a beach. While such a measure would have several benefits -- provide more public safety, maintain the resource for coastal tourism, and protect the property tax base – communities yet have to decide on their reasons for such adaptation measures and it will affect the ranking of municipal priorities. Clearly, these trade-offs entail difficult policy decisions and may have little to do with how much or valuable information about global change and sea-level rise is available locally.

[7] An example for the former comes from Hawai'i: the contradictory approaches of the Department of Land and Natural Resources (DLNR) and the Department of Transportation (DOT) to beach management. While the DLNR increasingly favors and works toward no-hardening rules, beach nourishment, and long-term strategic relocation away from high-hazard areas, the DOT prefers hardened shorelines to protect coastal infrastructures (e.g., roads) in place because beaches create additional maintenance problems. Both argue that over the long-term their preferred strategy is the more cost effective one. Another scale-related example from Hawai'i is competition across scale: counties regulating Special Management Areas, setbacks, and floodplain areas are required to assure public safety <u>and</u> they have a strong economic interest in expanding their tax base, i.e., to encourage and allow development at the lucrative oceanfront. The DLNR, on the other hand, is charged with preserving and extending the public good of beaches and access to them. Where coastlines experience long-term erosion trends, there is a clear conflict in goals even if both authorities adequately adhere to the rules and regulations they each administer.

[8] There are also turf issues regarding the importance of different types of knowledge, e.g., Native or other local, lay knowledge versus scientific expertise.

[9] An interesting twist emerged again in the case of Hawai'i. Not only in times of economic crisis, but in particular during such times, states look to the federal government for support. In the case of the 50th state of the Union, such requests can only be adequately understood in the historical and geographical context of the frequently tense relationship between Hawai'i and the US mainland and Hawai'i and the federal government which emerged frequently in the interviews. Federal agencies, unless they are locally based and staffed by local residents ("local feds"), and US mainlanders are commonly and skeptically viewed as outsiders. Historically, many Hawai'ians see themselves as having been forced into the federal union, and since then many perceive their state as being "forgotten" by the federal government. Far away from the political centers of the US, much attention of the Hawai'i Coastal Zone Management Program is focused on getting federal financial support at the same time that it tries to shield the state and counties from federal interference in coastal affairs.

[10] The history of institutional restructuring in Hawai'i is a case in point: the HCZMP was housed at various times in the Governor's office and during those times enjoyed greater political visibility and direct influence in the legislative realm than at other times.

[11] Hawai'i is the only US state that does not have a geological survey.

[12] Based on a review of the Subcommittee on Global Change Research's (SGCR) Supplements to the President's Budget, in fiscal year 1997, there were 99 global change-related research programs (plus 14 hardware development programs within NASA), each supporting numerous individual research projects, which were conducted under the auspices of twelve federal departments and agencies (SGCR 1996). In fiscal year 1998, with a slight reduction in overall USGCRP budget, there were 94 programs (plus 19 hardware development programs within NASA) offered through eleven agencies and departments (SGCR 1997).

[13] The text of the Act is available from http://www.gcrio.org/gcact1990.html.

[14] One of the affiliated programs of GCRIO is the Aspen Global Change Institute (AGCI). AGCI's mission is to "further understanding of Earth Systems through interdisciplinary science meetings, publications, and educational programs about global change science." It offers summer institutes and computer-based publications, including searchable abstracts, a quarterly update for educators, and publications and videos for K-12 (GCRIO April 1998 at http://www.gcrio.org/edu/educ.html). The Eighth Annual Aspen Global Change Institute Summer Science Session from July 30-August 7, 1997 --- entitled Global Environmental Change: Preparing for an Effective U.S. Assessment -- was aimed at preparing for the U.S. National Assessment with its particular focus on regional assessments (see Section 5.2.4).

[15] According to long-term observers of federal science policy, the OTA was abolished by Congress precisely because it was perceived to not produce enough 'usable information.' This being so, there is a significant pressure on the USGCRP to produce useful and policy-relevant science in order to keep the level of funding it currently enjoys ($725 million requested for research for FY 1998 (SGCR 1997, p.79)).

[16] The argument of potential global warming and SLR is used several more times in that act to push more forcefully for the implementation of the above cited management goals.

[17] Note however, that EPA websites still carry elaborate information on sea-level rise research undertaken within the agency (EPA 1998; Titus 1998).

[18] Very shortly after the EPA published its first major global change assessment in 1993, the National Research Council brought forth its own assessment (National Research Council 1983). The two publications differed significantly in tone and assessment of the severity of the threat (with the NRC assessment being more skeptical of doomsday scenarios and more careful in pointing out the scientific uncertainties). Because of the differences and the odd timing of publication, the two reports received significant media attention at the time (Easterling 1998).

[19] The EPA made additional research funds available for state greenhouse gas inventory studies. While these studies did not focus on sea-level rise specifically, they generally contain a section that discusses potential impacts of global climate change and possible local consequences, including sea-level rise in coastal states (for example for Hawai'i see State of Hawai'i, DBEDT, 1997).

[20] The Global Change Research Act states that the SGCR "shall prepare and submit to the President and the Congress as assessment which –

1. integrates, evaluates, and interprets the findings of the (USGCR) Program and discusses the scientific uncertainties associated with such findings;
2. analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and
3. analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years." (USGCRA, 1990, Sect. 104).

[21] Several GEA affiliates (Eileen Shea and David Cash) and GEA Summer Study attendees (at Bar Harbor, in June 1997) also participated in the Aspen Summer Institute. Their influence on the discussions and final recommendations that resulted from the Aspen meeting is borne out in the design suggestions for the National Assessment, and in their ongoing efforts to maintain what has come to be known as "the Aspen spirit," i.e., a real commitment to a regional, bottom-up component of the National Assessment and a commitment to process, not just to the production of periodic reports.

[22] Some of the concerns about the National Assessment discussed at the Aspen Summer Institute included: What type of assessment is possible given the information that is available? What are the steps that must be taken in order to retain interest at the regional level during the assessment process? What overall coordination and guidance is needed to integrate and synthesize the regional and sectoral efforts? What must we do to ensure that the findings of the national assessment reach stakeholders of all types and levels? What sort of communication process is needed? What must we do to ensure that the assessment process is seen as open and flexible? That it is seen as scientifically based and credible? (extracted from MacCracken, July 25, 1997, letter to Aspen participants).

[23] Kelley, Kelley, and Pilkey (1989) actually divide this last section geologically into two regions: the island-bay complex reaching up to Machias Bay and the cliffed shoreline compartment from there north to St. Croix/Calais at the upper end of the Bay of Fundy.

[24] Eustasy = sea-level movement relative to the land; isostasy = land movement relative to the sea.

[25] This amounts to 1-10% of the entire Maine coastline. An additional 20% are wetland/marsh-type coastlines, ~60% mudflats at the foot of rocky shorelines, and ~10% bluffs/ledges (Kelley 1992).

[26] According to the most recent full-scale population census in 1990, Maine had a total population of almost 1.228 million (USDC/Bureau of the Census, 1991). Later figures indicate a small rise to 1.239 million in 1993 (USDC/Bureau of the Census, 1994). In 1991, slightly over 72% of Mainers lived in one of the 10 coastal counties, and almost 43% (>530,000) of all Mainers lived in a town with at least some tidally influenced shoreline (as calculated from data provided by the USDC/Bureau of the Census, 1991; see also Maine State Planning Office, 1996, and 1994, p.6). In the summer, the population of small coastal towns doubles and triples, adding another 100,000 people to the permanent coastal population during the summer. According to Colgan and Plumstead (1995), population and employment grew in Maine's coastal counties from 1980 to 1992 by 14.6% and 32%, respectively, mostly in the Southwest and Midcoast counties. Colgan and Plumstead (1995) claim that in the Gulf of Maine region, tourism/recreation is the biggest income generating industry, followed by a declining, yet still crucial fishing industry and service and processing industries connected with it (increasingly also including aquaculture), with transportation-related activities playing also an important role (harbor traffic, ship building and repair, etc.) (cf. the partial data provided in the quarterly *State of Maine Economic Reports* or the Maine State Planning Office's annual *Year-End Reviews* of the state's economy, [Maine State Planning Office, 1995a, 1995b]).

[27] The beginnings of formal governmental concern over Maine's coastal zone date back much further, however, to the late 1960s, predating even federal efforts. For further details see Moser (1997).

[28] The LURC is a state agency but has duties similar to planning and zoning boards otherwise found at the municipal level. It is responsible for nearly one-half of the state and as such for much of Maine's natural resource base, including several coastal islands and small stretches along the Downeast mainland coast (DOC/LURC 1997a; DOC/LURC 1997b).

[29] For other coastal and marine resource management issues the Department of Economic and Community Development, the Department of Marine Resources, the Department of Inland Fisheries and Wildlife, and the Department of Transportation get involved as well.

[30] Maine Audubon Society is not a state chapter or the national environmental organization but an independent NGO.

[31] Occasionally, the Natural Resources Council of Maine in Augusta and the Conservation Law Foundation working out of its local Maine or its Boston-office get involved in coastal lobbying or legal disputes over coastal issues.

[32] Maine and New Hampshire form a joint sea grant college program. Its main office is housed within the University of New Hampshire.

[33] For a complete overview of all governmental, non-governmental, academic and other research, non-profit and commercial coastal organizations see COASTLINKS, a resource guide published by the Maine Coastal Program. It is also available on the internet at http://www.state.me.us/spo/mcp/index.htm.

[34] For a more complete review of legislation that pertains to Maine's coasts and their relevance to managing accelerated sea-level rise, see (Marine Law Institute 1995, Appendix A).

[35] Note that the Sand Dune Rules are part of Maine's Coastal Wetlands Act, and that has recently (in 1988) -- along with several other resource protection laws -- become part of the Natural Resources Protection Act. I continue to use the term Sand Dune Rules here because they comprise the heart of Maine's SLR-specific legislation.

[36] Work on climate change and its impacts continues, however, in other places. The Climate Change Task Force within the MSPO and other state agency input, for example, cooperates with MEPP, but is mostly focused on energy-related matters and air pollution (Desmeules 1998; Connors 1998; Anderson 1998). Maine has also conducted an EPA-funded Greenhouse Gas Inventory (http://www.epa.gov/ globalwarming/actions/state/state/maine, April 1998). And joint governmental and non-governmental efforts are underway currently to stage a climate change conference in April 1999 to raise public awareness and support for political measures to reduce greenhouse gas emissions (Beard, pers. comm. April 8, 1998; Anderson 1998).

[37] There is an additional erosion/sedimentation hot spot in southern Maine that has attracted considerable political and public attention, namely Wells Harbor. At the time of interviewing, an historic agreement had been reached after five months of intense and mostly closed negotiations (preceded by almost three decades of conflicts) between the town of Wells, the US Army Corps of Engineers, Maine Audubon Society, state agencies, the US Fish and Wildlife Service, SOS (Save Our Shores) Wells, and the Wells Chamber of Commerce (Maine Audubon press release January 21, 1998). The agreement includes a significant reduction in harbor dredging, habitat protection, scientific monitoring conducted by an independent contractor but overseen by all involved parties, and a commitment to a collaborative decision-making process in the future.

[38] Fran Rudoff (1996) mentioned that the 1995 SLR study report would be included in the deliberations of the Task Force; later interviewees, however, made no mention of the report.

[39] The graph is based on NASA (Goddard Institute for Space Studies) data.

[40] Fran Rudoff stated in (1996), "I think, I don't know that independent of the EPA putting this money out there for this project, that we would have said this is a high-enough priority for us to go off and study this. ... Presented with this opportunity -- sure, we'll take a look at that," since the project had "a logical connection with the work we had already been doing" (Rudoff, 1996). The Marine Law Institute, however, was the institution that initiated writing the EPA grant.

[41] Interestingly, the MSPO was reorganized a few years ago into teams dealing with related substantive problems to address the problem of undue fragmentation even within one agency, however, one with a great diversity of programs and tasks (Rudoff 1998; Connors 1998; MSPO 1998 at http://www.state.me.us/spo/org.htm).

[42] The Laudholm Trust is associated with the Wells National Estuarine Research Reserve. It produced several educational and outreach products on sea-level rise (including the mentioned flip-chart brochure,

a video, and a panel discussion to be held in June 1998) which came out of a marsh core study conducted by Joe Kelley, Dan Belknap, and George Jacobson at the Wells estuary (Kelley 1998; Belknap 1998); the last phase of that study required that the findings were brought to the public, that they "get the word out to the people" (Adams 1998).

[43] The "Board" is the Maine DEP's Board of Environmental Protection which makes policy decisions within that Department.

[44] For a detailed review of the history of the HCZMP from 1973-1990, see Hawai'i Office of State Planning/HCZMP 1990, pp.4-6).

[45] Hawai'i does not entertain an administrative level at the very local level, but residents can express their concerns on Neighborhood Boards (Oah'u) or in Community Associations.

[46] Hawai'i's early statewide zoning law is unique in the US.

[47] The equivalent authority in the City and County of Honolulu is the Department of Land Utilization.

[48] The shoreline is the mean high water mark or the debris line or – when either is absent – a line extrapolated between points along the coast where the high water mark or debris line is identifiable. The shoreline is certified by the state, and any certification is valid for one year. If development of oceanfront property occurs more than one year after shoreline certification, the coast has to be newly surveyed and certified at the time when a permit is requested.

[49] Note the proposed merging of the HCZMP with the OEQC described above. Arguments for and against this merger were aired during the MACZMAG Meeting on march 20, 1998 (MACZMAG Meeting Minutes, March 30, 1998).

[50] The Hawai'ian Sea Grant program is not only active in Hawai'i but also on other US affiliated or freely associated states in the Pacific region.

[51] In August 1995, the state's Supreme Court issued a decision in the highly visible Public Access Shoreline Hawai'i v. County of Hawai'i County Planning Commission case (known as the PASH decision). At the crux of the case lie the scope and nature of the constitutional and statutory access and gathering rights of Native Hawai'ians in order to pursue their customary and traditional practices. The PASH decision confirmed these rights, essentially demanding a new and comprehensive approach in assuring a better understanding of Native customs and in guaranteeing Native rights as well as privacy and property rights of other Hawai'ian residents. Because Chapter 205-A demands that cultural concerns are taken into account in coastal development decisions, the HCZMP is charged with, and currently in the process of, developing such a comprehensive approach (Hawai'i/DBEDT/Office of Planning/Coastal Zone Management Program 1997, pp.13-16).

[52] Private insurance companies are beginning to write policies for private homeowners again since the establishment of the relief fund. Experts expect, however, that in the case of a direct hit of Oah'u or Honolulu, Hawai'i will not be sufficiently covered (Clawson 1998; Hamnett 1998).

[53] A native Hawai'ian concept comparable to that of watershed-based management is that of "ahupua'a." It currently is discussed as a model for coastal zone management), especially on a local scale (MACZMAG Meeting, March 20, 1998).

[54] This aspect of Hawai'ian coastal geology is quite unique in comparison to US continental areas which usually have shelf areas with sand deposits and an old hinterland that supplies a significant amount of the sediment to the beach system. The sand supply to Hawai'ian beaches from modern coral reefs has not yet been quantified, but is estimated to make up only a very small portion (Fletcher 1998).

[55] For a comprehensive list of work on SLR and beach dynamics see the homepage of the Coastal Geology Group at http://www.soest.hawaii.edu:80/coasts/cgg_main.html. Fletcher is currently in the process of writing a long overdue book on coastal geology for Hawai'i. Co-authored with Orrin Pilkey and William Neal, the book (entitled *Restless Islands*) will appear in Pilkey's famous Living with the Shore series (Duke University Press) (Fletcher 1998).

[56] The SLR trends depicted in Figure 7 include the figure for Oah'u, measured at Honolulu which is believed to be a stable site. The SLR figure measured there thus reflects the average rate of global SLR according to the IPCC (Bijlsma et al., 1996, p.297).

[57] At the Workshop, Gerald Meehl from the National Center for Atmospheric Research in Boulder, CO reported of regional climate modeling research that indicates that the warming associated with a doubling of greenhouse gas emissions could result in the establishment of "El Niño-like" regional climate patterns in the Pacific (Meehl 1998). While further research is necessary to confirm these findings and contradictions with historical data need to be resolved (Vitousek 1998), Meehl's research suggests potentially severe consequences which Workshop attendees who are currently struggling with managing the impacts of this year's El Niño could directly relate to.

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