



# Is California Preparing for Sea-Level Rise?

THE ANSWER IS DISQUIETING

SUSANNE C. MOSER

“We basically have three choices: mitigation, adaptation, and suffering,” said John Holdren, the president of the American Association for the Advancement of Science and an energy and climate expert at Harvard. “We’re going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required and the less suffering there will be.”

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CALIFORNIA COASTAL RECORDS PROJECT

**L**ATE LAST YEAR, SUSANNE MOSER completed a survey on how coastal managers in California are responding to accelerating sea-level rise. The survey was designed to assist the state in identifying what coastal communities need in order to adapt to impacts of global warming. She has been presenting the results to uneasy audiences ever since. This article is adapted from her talk at the Coastal Commission's Climate Change Workshop on December 14, 2006, in San Francisco.

Let me begin by placing my study into the broader context of what is happening in California. In June 2005, Governor Arnold Schwarzenegger signed Executive Order S-3-05, in which he not only set stringent emission targets, but also asked for regular updates on the state of the science of climate change, how well California is meeting the emission reduction targets, and the status of "mitigation and adaptation plans to combat the [expected] impacts" from climate change. The study we conducted for the state on coastal managers' preparedness for climate change is a direct response to the last part of this request.

A year later, in the summer of 2006, California's Ocean Protection Council released its strategic plan. Several of its objectives and priority areas speak directly to the need for the state to begin preparing for climate change. These goals were reinforced in September 2006, when the governor and his colleagues in Oregon and Washington signed the West Coast Governors' Initiative on Ocean Health. In short, key leaders in the state recognize the need to slow down global warming and get ready for impacts we cannot avoid.

Clearly, much is at stake, and California's coastal managers already have a difficult task at hand. The state's 1,100 miles of open ocean coast, and another 1,000 miles of bay coastline, are major attractors for development, economic activity, tourism, and recreation. Managers are charged with meeting multiple and sometimes conflicting coastal management objectives, ranging from ensuring public safety to protecting natural habitats, to fostering a vibrant coastal economy. These goals will be increasingly difficult to achieve as the risks grow from the combined impacts of climate change.

According to the latest study conducted for California, sea level is projected to rise by about four to 28 inches over this century. As this occurs, we should expect species and habitat shifts (e.g., wetlands wanting to move inland but being hemmed in by development along the shore, a situation dubbed the "wetland squeeze"). In addition, experts expect changes in coastal storms (including possible changes in storm intensity, frequency, and tracks), increasing coastal erosion, more coastal flooding, and faster cliff retreat. Rainfall and runoff patterns are also expected to change. These changes are not just projections for the future; they are already apparent. For example, more precipitation is already coming as rain rather than as snow in the winter, and as it runs off sooner, coastal communities see both more flooding and longer dry periods with less water available in the summer. This pattern also affects water quality: a heavy storm after a long dry period leads to big runoff, which may be heavily polluted with contaminants from roads and fields; as it runs into coastal streams and the coastal ocean, water pollution problems become more serious. Scientists also expect a rise in coastal water temperatures, which likewise will affect water quality. Less oxygen in the water means less favorable conditions for all marine life that depends on oxygen, and so we may see more fish kills.

It should be noted that these are conservative estimates. The relatively modest sea-level rise projections mentioned above are based on the assumption that the ocean will rise gradually, as ice on land melts down slowly and warming ocean waters expand. But that does not account for more recent science, which says Greenland and West Antarctica may melt down much faster than we thought. Of course, if sea level will rise several times faster than we have witnessed in the past, the types of impacts described above—in some sense already familiar to coastal managers today—will become dramatically worse.

In our study, we examined whether coastal managers in California are aware of these projected changes, and what, if anything, they are doing to prepare their communities to deal with the risks and challenges associated with global warming. While the state has looked at basic adaptation options in various sectors before, ours is the first study to look at actual preparedness "on the ground." It delves into the questions of awareness, attitudes, capacity to use available

**Opposite page: At Gleason Beach, about five miles south of the Russian River in Sonoma County, several houses slid onto the beach during the 1998 El Niño. Remaining structures are at risk of following them.**

global warming information, and actions already taken to plan for climate change (or barriers to such action) in California coastal communities. The study was sponsored by the California Energy Commission and California Environmental Protection Agency through a grant to the California Climate Change Center.

The responses we obtained reflect the state of awareness and preparedness in the second half of 2006. While I have done related research in nine other coastal states in the United States, this is the only study to my knowledge that looks at what local coastal managers think about adapting to climate change. In my opinion, these local managers are critical to understanding “real” preparedness, because they are the ones responsible for implementing coastal policies on the ground and thus are at the forefront of preparing for climate change impacts.

## The AAA of Adaptation

IN OUR STUDY WE LOOKED AT THREE aspects of preparedness—the Triple A of Adaptation: awareness, analytical capacities, and action. First, are coastal managers at the local level—permit officers, planners, water managers, civic engineers—aware of and thinking about the risks associated with global warming? Do they know what climate change really means? Second, if they are aware, how do they use the information they have? Can they translate scientists’ projections into something they can act on in their daily work, in the decisions they make? We call this managers’ analytical capacity. And finally, are they already developing policies and taking action? Are managers taking this information—such as the fact that flooding will get worse, and flood levels higher—into account in long-term planning, in emergency plans?

In early 2006, we interviewed 17 federal, state, and regional officials—managers actively involved in coastal zone management in California, from agencies ranging from the Army Corps of Engineers to the Department of Boating and Waterways to the Coastal Commission. Based on what we learned, we developed a comprehensive survey and in the summer of 2006 sent it to 299 municipal and county coastal managers—people who do everything from issuing permits to managing stormwater flows, water quality, public works, and so on. About half the people responded, which is considered a fairly high response rate for a survey. We received responses from nine out of ten coastal cities and 90 percent

of all coastal counties, so the results give a fairly good indication of what’s going on. The 18-page survey sought answers to the following questions: What are your current challenges and how do you deal with them? What are your attitudes about global warming? How do you think global warming and related impacts such as sea-level rise might affect your local area? What have you done to prepare for those impacts to date? If no plans are in place, what are the barriers to beginning to prepare? And what would you need in order to act—more information, more training, or something else?

## Awareness of and Attitudes toward Global Warming

TO LEARN HOW AWARE MANAGERS ARE of climate change, we asked if they agreed or disagreed with various statements. For example, “Global warming is already happening now.” Over 90 percent responded that they “agreed” or “agreed strongly” with this statement. This answer reflects a very high level of awareness about this issue, a level I have not seen in other states.

As another way to gauge attitudes toward global warming, we asked: “What is your personal level of concern about global warming?” About 80 percent responded that they are “very concerned” or “concerned,” again signaling an exceptionally high level of concern.

Next we asked: “What are your attitudes toward preparing for the impacts of global warming?” We found that the vast majority, over two-thirds of respondents, are ready to prepare for the most likely climate-change scenario based on the best available scientific information. A few percent of respondents said they are willing, in all of their decisions, to prepare for things getting worse; about a third said, “I want leadership from on top” or “I can’t deal with this because I have too much else on my plate;” and approximately 15 percent stated that they would “rather wait to act until they get better information.” Those unwilling to take action right now make up an important segment of the population, but overall we found that a significant majority of coastal managers in this state are very concerned *and* ready to act.

We then asked respondents how informed they felt about global warming. The vast majority said they are “moderately well” informed. When we probed a bit, we learned that people basically get their knowledge about global warming from the



news media—the papers and TV news. Very few said they are very well informed and very few admitted that they don't really know anything. So although we found that people are concerned and ready to act, their understanding of the issues is somewhat superficial.

## Translating Science into Information for Decision-Making

UNDER THE SECOND A OF THE TRIPLE A of Adaptation, analytical capacity, we tried to find out whether managers were capable of translating technical information into “usable science” for decision-making. We began by asking whether they have the information they need, and what else they might need, to begin preparing for climate change impacts. In one question, for example, we gave several options: Do you want (1) short-term weather and seasonal climate forecasts, (2) regional climate change projections for the next few years, (3) information about what is most vulnerable or at risk in your community, or (4) locally specific projections of various climate change variables, such as changes in temperature, rainfall, and sea-level rise? What our study revealed is that for coastal managers, the most important type of information is the vulnerability assessment for their communities: people want to know what will be most at risk. By identifying what is most vulnerable, they get a better idea of what to do and what else they may need to secure their local area against possible impacts. Managers are very clear in saying, “I don't want generalized forecasts of warming for the globe. I want to know: Can I still meet my management objectives? How far back do I have to tell people they have to build? How does sea-level rise translate into a retreat rate?” As a result, I highly recommend that scientists and state agencies avoid the “loading dock” approach of providing local managers with more and more information in the form of reports and statistics. People need not just information; they need to know how to *use* that information. They also want to know what other communities have done.

In addition, respondents clearly stated that they want to know how climate changes and the effects these will have on the ocean translate into project-relevant timeframes—the sorts they deal with on a daily basis, encompassing five, 10, 25, 50, or at most, 75 years. With regard to flood zones, for example, they asked such questions as:

Do we need to remap our flood zones? Can scientists project how flood zones may look different under higher sea-level scenarios? Right now the state is attempting to update flood-zone projections; however, this effort makes no attempt to project how flood zones may be altered as a result of climate change.

We then asked about the kinds of tools managers use now to process information. The answers to this question are important because they indicate managers' capacity to transform scientific information into something they can use in their decision-making. We learned that managers mostly use maps and GIS, and to a far lesser extent more sophisticated analytical or forecasting tools. The message here is that if we give people fancy models and projections that they don't know how to integrate into their daily decision-making, they will be less likely to use them effectively. Instead, the scientific community must translate technical data into practical information, presenting it in formats that are already commonly in use. For example, rather than providing a nice diagram of sea-level rise over the next 100 years, we must create regionally specific maps and GIS layers depicting more easily observed events such as flooding, beach erosion, and cliff retreat. This presents new challenges that scientists must tackle to link up climate-change information more directly with decision-making.

Solana Beach



## Actions Taken and Barriers to Preparing for Climate Change

FOR THE LAST A OF THE TRIPLE A OF Adaptation, we asked what actions communities had already taken to prepare for climate-change impacts such as sea-level rise, or if they had not, what barriers prevented them from doing so. The responses were sobering: When asked if they had started to think about global warming in their management and planning efforts, only two counties, San Luis Obispo and Sonoma, replied that they have plans in place that consider the effect of climate change, and neither of these considers coastal impacts. Only one city, Berkeley, has such a plan.

Somewhat more encouraging is the fact that six cities and four counties are currently preparing such plans, some of which will look at what sea-level rise and global warming might mean to them locally.

More than two-thirds of the respondents said their communities had not begun planning for the impacts of climate change, and nearly 20 percent didn't know whether their communities had any such plans. In some instances, we found respondents from the same local government contradicting each other—a reflection of the all-too-common situation of different departments not knowing what the others do. A lot of things could be improved if people talked more with each other, but of course, that won't fix everything.

When we asked why individual communities had not yet begun planning for climate change, the responses were revealing. Fifty percent or more of local coastal managers mentioned five major barriers to action: insufficient local funds, insufficient staff resources, no financial assistance from either the state or the federal government, no legal mandate, and simply

being overburdened: "We have too many things going on as it is."

An additional option on the survey was that "the science is still too uncertain," but that didn't figure highly in the responses.

The pressing coastal management challenges that currently occupy these managers include inland and nearshore water quality issues, inland flooding, species and habitat protection, coastal erosion, coastal flooding, public access, and salt-water intrusion. Because all of these will become more problematic with global warming, in some respects climate change will just be bringing more of the same. But because managers feel overburdened as it is, they can't even make the time to find out that climate change and sea-level rise won't bring something fundamentally new, different, or "extra," but instead worsen the problems they face daily now. And, as our survey revealed, coastal managers already feel they have too few resources to address the issues they currently face. In other words, they need help. Specifically, they need time, resources, and technical assistance to begin looking at the growing risks associated with climate change.

At the state level there are some agencies, including the Coastal Commission, that have considerable expertise on climate change and what it might mean for coastal areas, but the motivation to act on that expertise varies. Some agency experts are as yet unwilling to tackle the issue of climate change because they perceive it as politically charged; others simply don't know how. Although some experts, both in public agencies and in the state's research institutions, stand ready to develop the information that managers need, generally speaking the scientific expertise in the state is inadequately connected to those who need it most.

At the local level, most people put out one fire at a time—or keep one house at a time from







falling off the cliff. Nothing in their agency mission or job description says they also need to look at climate change. They will only start dealing with global warming impacts once that becomes part of their job description, because then it will be part of their responsibilities and they will be accountable.

It is also important to realize that our results, though hardly encouraging, may still be too optimistic. About 50 percent of the people to whom we sent the questionnaire did not reply. I think that people who have something to tell, such as those who have begun to act on climate change, and those who are motivated to do an excellent job, are more likely to respond to such a survey, while those who have not yet taken action on global warming are less likely to do so. Thus the summary here is probably too rosy a picture of the overall situation in coastal California.

Given that the scientific projections of what's ahead are becoming ever more alarming, what can be done to help those who are in charge of decisions about our coast? I think the Coastal Commission has an important opportunity to take on a leadership role by instituting an official

policy that makes climate change a central consideration in coastal development and management. Today, there are critical constraints on local coastal management that prevent best practices. As a first step, these should be addressed. In addition, the Commission could take a serious look at those communities that are willing to be the pioneers and take action. Developing response options with those ready to lead will be important, because those are the communities others will look to for answers later on.

## Postcard to our Grandchildren

CLIMATE CHANGE WILL HAVE SIGNIFICANT impacts on a part of the California landscape that is vital to the state—ecologically, economically, and culturally. I was recently in New Orleans and saw with my own eyes the devastation inflicted by Hurricane Katrina. I can tell you that the time for preparation is now, not when the crisis is upon us. If you start thinking about making changes only after a catastrophe hits, it's too late.

People face many constraints that keep them from doing the best they can right now. Managers told us they want technical and financial assistance, as well as a legal mandate, or at least

**The outlined areas on these maps from the San Francisco Bay Conservation and Development Commission show regions that would be submerged by sea-level rise of one meter. At left is the Foster City and Redwood City region, at right is Oakland Airport.**



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**Heavily armored shoreline at Del Mar Avenue, San Diego**

an official policy. People want leadership. They need these things in the face of ongoing development pressures and the demands of special interests. They need specific information, but they also need help to use that information, and opportunities to exchange relevant experiences with colleagues.

California is a national leader in addressing greenhouse gas emissions—that is, in working to reduce the pace and magnitude of global warming. However, top state leadership is lagging behind in its readiness to address the unavoidable impacts of climate change. An important public conversation about adaptation is yet to be had. Some may view a discussion of adaptation as a form of capitulation, as giving up on mitigation, but that is outdated thinking. The impacts we are already seeing are taking place because of emissions we released into the atmosphere decades ago. They are, in a sense, a postcard from the past. What we do today should be viewed as a postcard we’re sending our children and grandchildren, for delivery 30 years from now. No amount of mitigation today will diminish the impact of the heat-trapping gases we have already emitted. We have already committed ourselves to additional climate change, and will have to deal with those impacts. Adaptation, therefore, should be seen as a complementary necessity to mitigation. There is no way around it: we need to start a public dialogue that acknowledges these reali-

ties, and begin discussing how we will deal with these unavoidable impacts.

Moreover, there is no way, given the increasing challenges we face from global warming, to avoid addressing some long-standing taboos: population growth and development pressures in the coastal zone, for example, which place more and more people and expensive structures in harm’s way. Addressing this clash will raise uncomfortable questions about long-term retreat from the shoreline, private property rights, the role of government in protecting the public from risk, and so on. The onus is on the Coastal Commission and other agencies to take a strong leadership role in protecting California’s precious coastal resources and environments, while maintaining a vibrant coastal economy. Some tough decisions will have to be made. Such leadership will likely be unpopular among vested interests in the near term, but it will pay off in the long term—even in the face of climate change—if it allows coastal California to remain a cultural and economic magnet. ■

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