



Photo Credit: Phyllis Grifman

Our Changing Climate: Learning and Adapting

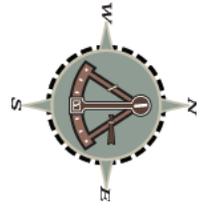
Ship to Shore: Linking Science to Policy

Global climate is changing. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: “a change of climate which is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods.”

Impacts from climate change include increased rates and scales of sea level rise due to the rapid melting of polar ice caps, potentially increased severity and duration of storms, changing weather patterns (increased drought in some locations, increased rain in others), and increased ocean acidification due to dissolving atmospheric carbon dioxide (CO₂) into ocean waters. These impacts pose substantial threats to both coastal ecosystems and communities. USC has a number of researchers tackling many of these issues and USC Sea Grant is funding these researchers and others to advance the science of climate change.

Like all coastal societies worldwide, Los Angeles and other seaside California cities face very real threats. The potential future economic impacts are likely to be measured in billions of dollars. While not related to climate change, events such as the recent tsunami in Japan, and the subsequent impacts on coastal cities in California, provide a frightening snapshot of worst-case scenarios of flooding. There are lessons to be learned from these kinds of events and we are on the front lines of this analysis.

Even as most cities and communities continue to find ways to mitigate impacts on our changing climate (for example by trying to reduce their CO₂ emissions in daily operations), many have also realized that they need to start planning for impacts that are already starting to be felt. *(Continued on page 2)*



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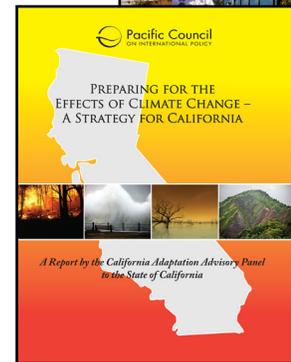
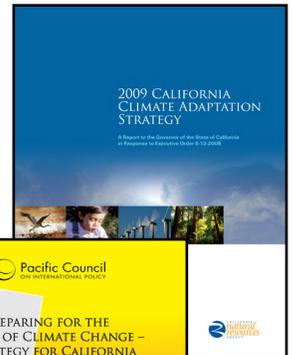
URBAN MARINER

Sea Grant
University of Southern California

Ship to Shore (cont'd from pg. 1)

At the state level, in 2009, California developed a Climate Change Adaptation Strategy. And more recently, in the fall of 2010, a Governor's Advisory Panel, led by USC Professor Dr. Daniel Mazmanian, released its report "Preparing for the Effects of Climate Change - A Strategy for California." Most recently in March 2011, the California Ocean Protection Council passed a resolution on sea level rise, providing guidance to state agencies on how to prepare.

The impacts of climate change are daunting and few easy solutions are immediately evident. However, as the science continues to advance, we can better forecast the impacts headed our way, and communities can work to find ways to increase their preparedness for and resilience to the impacts of our changing climate. USC Sea Grant and other government and non-governmental organizations are developing tools and trainings to assist coastal decision-makers in their planning efforts. Through this work, we have created a number of close collaborations across the state and nationwide. Throughout this issue, we highlight our key partners, who are critical to successfully addressing impacts and adaptations to climate change.



At the Helm: From USC Sea Grant



Phyllis Grifman,
Associate Director,
USC Sea Grant

As the Urban Ocean program, USC Sea Grant has long focused on the impacts of human activity on coastal ecosystems, such as urban runoff, trampling in tidepools, and coastal development. USC Sea Grant is now at the forefront of tackling climate change and its ensuing impacts on a highly urbanized coast. Sea level rise due to warming in the polar regions (and melting ice caps) among other climate change impacts threaten coastal infrastructure, from private residences to businesses and industry to international ports; ocean acidification potentially threatens Pacific shellfish fisheries. Over the years, USC Sea Grant has funded many researchers who have studied science relevant to climate change, as well as the roles humans play in heightened impacts.

Responding to climate change in a way that minimizes infrastructure loss and financial impacts requires good decision-making and planning - *by people*. The role of social science research has never been more relevant or more important. This year, with leadership from the National Sea Grant Office in Washington, D.C., USC Sea Grant, in coordination with the three other west coast Sea Grant programs (CA, OR, and WA) solicited proposals for regional social science projects. Several of these projects focused on climate change adaptation planning across state boundaries, as partnerships and coordination will be critical for effective planning for issues as large as climate change. This is a new path for Sea Grant; one that will certainly provide a complement to the cutting-edge science Sea Grant has always funded.

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Scientist's Quarters

Climate Change in the Southern California Bight

Climate change impacts will affect both the ocean and coastal communities. The implications of these changes are even more complex in a marine setting that borders a densely populated major urban area, such as the greater Los Angeles basin.

In 2010, USC's Dana and David Dorsline College of Letters, Arts and Sciences funded a three year collaborative project entitled *Climate Change in the Southern California Bight*, directed by Dr. David Hutchins and Dr. Douglas Capone (USC Biological Sciences, Marine Environmental Biology program). The goal of this project is to bring researchers from the College together to consolidate existing data with the aim of advancing climate change science in the region and developing education and outreach opportunities for students and interested citizens. Co-Director, Dr. David Hutchins, comments:

It has been evident for some time that there is a need for a regional ocean climate change information clearinghouse to facilitate communication and cooperation between various marine science groups, as well as with the broader academic community and general public.

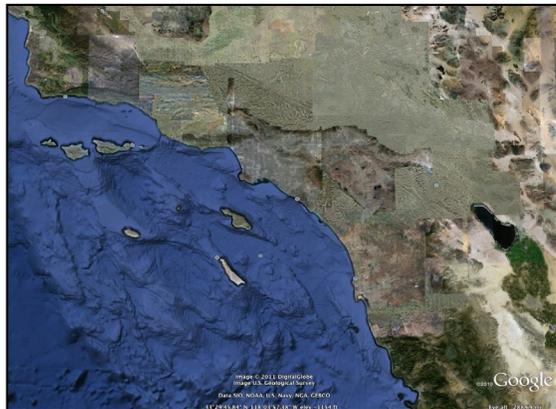
Because much of oceanographic research is done in collaboration, other regional research organizations and institutions have been invited to participate in this project (see partner box below). USC Sea Grant, in addition to having funded several of the studies that yielded oceanographic data that will be included in the overall analysis, is a partner in the education and outreach effort of this project. As Co-Director Dr. Douglas Capone notes:

USC Sea Grant is an integral and full partner in our efforts as they already have a well established network of many of the relevant partners that we want to involve and with whom we share the objectives of raising awareness of the general public to the pressing issues of climate change in coastal environments.

The first meeting was held in fall of 2010 and focused on identifying all the relevant ongoing research and data sources and repositories. Preparations are underway for a Town Hall meeting in the fall of 2011, which will discuss the policy implications of climate change to the natural and built environment of the Southern California Bight.



Researchers use many tools to gather oceanographic data in the Southern California Bight. These researchers deploy a moored buoy to remotely monitor the ocean over long periods of time. (See Fall 2010, Urban Mariner: Keeping an Eye on the Ocean, Photo Credit: CINAPS)



Climate Change in the Southern California Bight Partners

- Jet Propulsion Laboratory, California Institute of Technology
- Los Angeles County, Los Angeles City, and Orange County Sanitation
- National Marine Fisheries Services
- Santa Monica Bay Restoration Commission
- Southern California Coastal Ocean Observing System
- Southern California Coastal Water Research Project
- University of California, Irvine
- University of California, Los Angeles, Institute of the Environment
- University of California, San Diego, Scripps Institution of Oceanography
- University of California, Santa Barbara- San Diego State University

Google Earth image of the Southern California coastline. (Photo Credit: CINAPS)

In Depth: About the Research

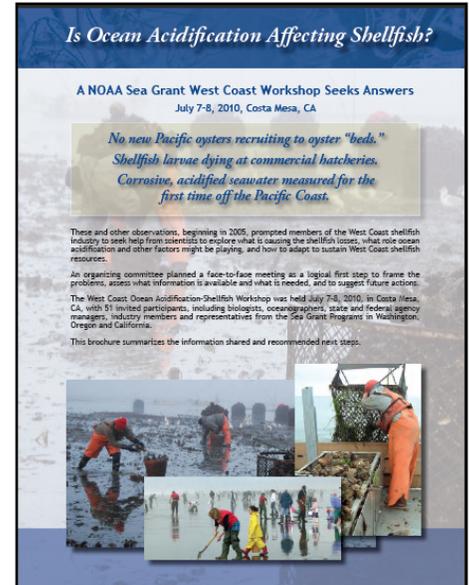
Climate Change Science

Climate change impacts are already beginning to affect our marine ecosystems. Increased carbon dioxide in the atmosphere is dissolving into the oceans, leading to increased ocean acidification. This has impacts on corals and shellfish. Water current patterns and temperatures are changing, leading to shifts in species habitats and ranges. USC Sea Grant has several projects investigating these issues.

Ocean Acidification and Pacific Shellfish

Many have certainly read reports about the effect of ocean acidification on corals in the tropical and subtropical seas. As the water becomes more acidic, it becomes more corrosive to organisms that have carbonate exoskeletons, such as corals. Shellfish like clams, oysters and mussels also have carbonate exoskeletons, so there is growing concern that this increased acidity is also beginning to affect our local shellfish fisheries.

In the summer of 2010, USC Sea Grant along with Sea Grant programs in California, Oregon and Washington and shellfish industry representatives co-sponsored a workshop with representatives from the west coast shellfish industry to open a dialogue among shellfish harvesters, shellfish aquaculture growers, and researchers at the forefront of ocean acidification studies (see partner box below). Fifty participants were invited, including state and federal managers, industry representatives, and leading academic researchers and oceanographers with expertise in larval recruitment, laboratory studies, and ocean chemistry.



Ocean Acidification Workshop Partners

- California Sea Grant
- Oregon Sea Grant
- Washington Sea Grant
- Pacific Coast Shellfish Growers Association
- NOAA Pacific Marine Environmental Laboratory
- California Wetfish Producers Association
- Bruce Steele, California sea urchin diver
- Southern California Coastal Water Research Project
- University of California, Santa Barbara

One result of this workshop, was the creation of the California Current Acidification Network (C-CAN). This network is composed of shellfish growers/harvesters, researchers, and state agencies. They are working to tackle workshop recommendations, which include establishing best practices and standardized research methods and developing a data exchange portal for information regarding ocean acidification processes affecting west coast fish and shellfish. For more information, please visit: <http://www.sccwrp.org/Meetings/Workshops/OceanAcidificationWorkshop.aspx>



Left: Power stations like these, in addition to other types of industry and automobile emissions, are implicated in increased CO₂ emissions to the atmosphere - one of the causes of increased ocean acidification. Right: A purple urchin in the rocky intertidal California coast. These urchins, and other organisms with carbonate exoskeletons, may be at risk from increased ocean acidification. (Photo credits: Charlotte Stevenson, Paul Matson)

Climate Change Adaptation

Decision-makers in Southern California's coastal cities and counties generally recognize that climate change will impact their communities and coastline. Sea level rise threatens coastal infrastructure and wetlands; increased storminess could lead to damaging floods and mudslides. However, California's coastal communities are at different stages in developing and/or implementing climate change adaptation plans. At USC Sea Grant, we are working with local communities to help them wherever they are in the process of climate change adaptation planning.



Many Southern California homes are at risk from sea level rise induced erosion - examples of one of the challenges facing adaptation planning by local officials. (Photo credit: Phyllis Grifman)

Taking the Pulse: Climate Change Adaptation Needs Assessment Survey

With funding from the National Sea Grant Office, USC Sea Grant set out to conduct a survey in Los Angeles County to better understand the community's climate change adaptation needs. In discussions with partners across California, it quickly became clear that a survey such as this was needed on the statewide scale. With supplemental funding from the the Center for Ocean Solutions at Stanford and the California Nevada Applications Program through NOAA's Regional Integrated Sciences Assessment Program, this survey developed into a partnership with an incredibly engaged group of partners across the state.

The survey will be administered in the spring of 2011 and is heavily based on a similar survey conducted in 2005 by Dr. Susanne Moser and Dr. Joe Tribbia (National Center for Atmospheric Research)¹. The results from their survey showed that managers need more than just information on climate change; they noted that "lack of staff, financial, and technical resources, as well as lack of time and a legal mandate to address climate change [were found to be] the primary obstacles to preparing for climate change." In their recommendations for next steps, Moser and Tribbia suggested that "boundary organizations"—organizations that bridge the gap between science and policy, such as USC Sea Grant—could play an important role in transferring information between scientists/researchers and policy/decision-makers.

This survey will be the first-of-its-kind longitudinal study on climate change adaptation in the nation. USC Sea Grant and CA Sea Grant are working closely with other Sea Grant programs to determine if this survey can be used on the national scale.

Climate Survey Partners

- California Coastal Commission
- California Nevada Applications Program through the NOAA Integrated Regional Sciences and Assessments Program
- California Ocean Protection Council
- California Ocean Science Trust
- California Sea Grant
- Center for Ocean Solutions, Stanford University
- Coastal Services Center, National Oceanic and Atmospheric Administration
- ICLEI—Local Governments for Sustainability
- San Francisco Bay Conservation and Development Commission
- San Francisco Bay National Estuarine Research Reserve
- Southern California Coastal Ocean Observing System
- Susanne Moser Research & Consulting
- Tijuana River National Estuarine Research Reserve



Survey partners at a planning meeting in Oakland, CA, discussing needs and challenges of a CA-wide climate change adaptation needs assessment survey. (Photo credit: Juliette Hart)

1. Moser, Susanne C., and John Tribbia. 2007. More than Information: What California's Coastal Managers Need to Plan for Climate Change. California Energy Commission, PIER Energy-Related Environmental Research Program. CEC-500-2007-046.

Getting Underway

Teaching Climate Change

USC Sea Grant, in partnership with Center for Ocean Sciences Education Excellence (COSEE-West), led the development of a special educator workshop in 2009 on climate change and its local impacts. With the expertise of local scientists working on climate change issues, COSEE-West and Sea Grant helped participants to learn ways to talk about climate change and to develop tools and activities to help explain difficult climate change topics to all ages. Many of the participant centers have since incorporated education on climate change into their programs.

In fact, the Channel Islands National Marine Sanctuary (CINMS) Education Team found this workshop so useful, that with the help of USC Sea Grant educator Linda Chilton, they used the COSEE-West model and honed it for their Sanctuary Docents. In the fall of 2010, COSEE-West and the Channel Islands Education Team offered this climate change docent workshop to docents in the Ventura and Santa Barbara area who work with the National Parks, CINMS, Ty Warner Sea Center and the Santa Barbara Natural History Museum. While 30% of the participants said they had a good understanding of ocean acidification before the workshop, at the conclusion, 95% indicated that they felt well informed about the topic. Supply kits were put together for the participant organizations to use and to take back to their centers to enhance their lessons. The hands-on resource kits that were developed for each of the participating institutions were recently used with great success at the National Science Teachers Association Conference in San Francisco. The workshops and resources were captured and provided on line at: <http://www.cisanctuary.org/acidocean/workshops.php>

COSEE-West continues to provide online and in person workshops on climate change in partnership with Jet Propulsion Laboratory at the California Institute of Technology and others. More information and downloadable resources from these workshops are available at: <http://www.usc.edu/org/cosee-west/resources.html>



A workshop participant learns a helpful activity to understand climate change. Like CO₂ dissolving into the ocean, the CO₂ in your breath acidifies water. (Photo Credit: Laura Francis, CINMS)



COSEE-West (Center for Ocean Sciences Education Excellence), funded by the National Science Foundation, was started in 2002 as a partnership with the University of California at Los Angeles, the College of Exploration in Virginia, Los Angeles Unified School District and a number of Southern California informal science centers and aquaria. USC Sea Grant plays a leadership in COSEE-West through the work of Dr. Linda Duguay, Lynn Whitley and Linda Chilton.



Another workshop participant demonstrates the “whale foodweb” jenga game - another educational tool developed for these workshops. (Photo Credit: Laura Francis, CINMS)