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Chapter 5: Develop a Local Action Plan **Adapting to Climate Change**

DOCUMENT CONTENTS

There are a number of daunting risks that communities eventually need to manage as climate change continues and the broader weather-related affects of global warming become more obvious. The full extent of the positive and negative implications, scope and pace of these effects are not 100% understood, but it is agreed that increases in greenhouse gases loading in the atmosphere will cause such impacts as:

Rising sea levels flooding low-lying coastal plains across the world, forcing population centers to evacuate and damaging trillions of dollars worth of infrastructure;

Different precipitation and temperature patterns impacting livestock and crop production, water supplies, health of forests, biological diversity, wild-life habitat, coastal and inland wetlands, vegetation and stream flow;

Increased insect reproduction rate and expanded geographic distribution of vector-borne disease;

More frequent and more severe summer and winter storms, including hurricanes, tornadoes and floods, and more frequently occurring events characterized by extreme heat, cold or drought conditions, including wildfires, windstorms, hailstorms and ice storms;

Loss of economic output and local tax revenues due to extreme weather conditions, missed work days, power failures, decreased tourism, property damage, property devaluation, and loss of crops and livestock;

Increased human health impacts derived from increased emissions of SO_2, NO_x, CO and particulate matter resulting in higher levels of ground-level ozone, lung disease, emphysema and asthma; *and*

Higher sickness or mortality rates of elderly and ill people due to extreme heat and cold or inability to leave their homes for medical or other purposes.

Managing these effects of climate change will require planning,

investment of resources, outreach to the community and coordination of multiple agencies on both the local and federal level. This chapter briefly describes a some of the strategies for managing these potential impacts.

Emergency Planning

On average, the federal government needs 72 hours to marshal national resources in response to an incident that has surpassed a state's response capacity.[1] Usually, a 72-hour delay is not a problem. State and local governments manage most of the responders that arrive immediately at a disaster scene and, in most circumstances, have the critical assets needed to carry themselves through the first three days. This was largely the case even during terrorist attacks, such as the bombing of the Alfred P. Murrah Federal Building in Oklahoma City and both attacks on the World Trade Center in New York City. On the other hand, when catastrophic disasters overwhelm state and local governments at the outset, as in the aftermath of Hurricane Katrina, the 72-hour buffer disappears, and any delays in a coordinated federal, state and local response cause serious consequences.

Better planning at regional and local levels are needed to prevent such shortfalls in disaster response. Such efforts need to take the form of city or state-based regional programs that focus on ensuring that local communities are prepared to sustain themselves and to facilitate cooperation among federal, state and local efforts. For example, in Dayton, Ohio, a Homeland Emergency Learning and Preparedness (H.E.L.P.) Center, which offers disaster preparedness training to emergency responders and the general public, has been supported at the state and city level.[2]

In the Homeland Security Act of 2002, Congress mandated that the Department of Homeland Security (DHS) set up a regional structure that coordinates and collaborates with state-based regional programs to help to close the 72-hour gap.

Rising Sea Levels

Rising sea levels is a potentially major result of climate change. There are many kinds of coasts, each with different ecological characteristics, economic values, and natural and human uses. In some areas, such as the remote shorelines in California or Oregon the sea is contained by high cliffs and rising sea levels will not be catastrophic. Segments of vulnerable, yet economically valuable, shorelines are often protected with hard structures such as seawalls. Although some coastal areas are somewhat protected by these structures, it is not known how sea level rise, sporadic storm activity, and shoreline hardening harm the ecological services of shoreline habitats. These habitats provide physical and biological buffers in estuaries and are essential to sustainable fishery production and other ecological values. In low-lying urban shorelines, such as Los Angeles, San Francisco, Miami and Manhattan, the impacts could be devastating. Sea level rise is not an easy process to predict or manage, because the rate of change and accompanying shifts in wave activity and storm surges are not well understood. City planners and resource managers have a big job in front of them.

The effects of sea level rise include tidal inundation of low lying areas; coastal erosion of wetlands, beaches, and other types of shores; vertical accretion of wetlands; increased coastal flooding during storm surges and periods of extreme rainfall; and increased salinity of aquifers and estuaries, especially during droughts.[3] Estuarine shorelines are already under the stress of increased water levels ranging from short term waves and storm surge to long term inundation through existing sea level rise.

[1] "State and Regional Responses to Disasters: Solving the 72-Hour Problem", The Heritage Foundation, by Jill D. Rhodes, J.D. and LL.M., and James Jay Carafano, Ph.D. Backgrounder #1962, at website: www.heritage.org/Research/HomelandDefense/bg1962.cfm, 15 August 2006.
[2] Homeland Emergency Learning and Preparedness (H.E.L.P.) Center, www.emhelpcenter.org/, 15 October 2006.
[3] For more information, U.S. Climate Change Science Program www.climatescience.gov, 12 August 2006.

The first and most important action that cities can take is to gather resource data about their shoreline and develop GIS (Geographic Information Systems) models to measure and model possible effects of climate change on coastal resources and human habitat. Many federal agencies and individuals are developing data that can provide insights regarding the implications of sea level rise.

For example, the Federal Emergency Management Agency (FEMA), the Army Corps of Engineers, and several states management. The National (Florida, Texas, North Carolina, and California) are developing elevation data for floodplain Oceanic and Atmospheric Administration (NOAA) and United States Geological Survey (USGS) are developing Digital Elevation Models (DEMs). Local governments and major coastal conservancies are developing GIS land-use data for managing ecosystems and economic activity. The U.S. Fish and Wildlife Service (USFWS) is developing wetlands data. These agencies all have information resources to help local and state governments develop their own models and action plans.[4]

Cities should work in coordination with counties, states and federal agencies in developing a baseline of resource data and models to help understand the full range of possible impacts of higher sea levels on local ecological resources, human habitat and economic activity. The following table provides names and contact information for the agency leaders who are working coastal issues related to climate change.

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USEPA	James G. Titus	Titus.jim@epa.gov
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USFWS	Brian Czech	brian_Czech@fws.gov
Corps of Engineers	Charles Chesnutt	Charles.b.Chesnutt@usace.army.mil
FEMA	Mark Crowell	Mark.Crowell@dhs.gov
DOE	Anjuli Bamzai	anjuli.bamzai@science.doe.gov
NASA	Eric Lindstrom	Eric.J.Lindstrom@nasa.gov

Table: List of key agency contacts working on sea level rise, August 2006

The program managers listed above are responsible for developing a report titled: "Coastal Elevations and Sensitivity to Sea Level Rise." The lead agencies are USEPA, NOAA, USGS. This report is available on line and will help city governments get started.[5]

Another information resource about adapting to climate change impacts is provided on line by the World Health Organization.[6]

Different Precipitation and Temperature Patterns

Yet another set of challenging issues city governments must plan to address for the safety and survival of their citizens are. changes in precipitation patterns and changes in average mean temperatures that could arise from climate change. These impacts are difficult to prepare for because the long-term effects of climate change on precipitation patterns and mean temperatures are still unknown. Temperature and precipitation patterns are both affected by cloud cover, wind, solar radiation, topography and numerous other physical features that are difficult for scientists to model.

Moreover, the impacts will vary regionally, meaning that cities will have to develop unique, local action plans. San Francisco's action plan for addressing change in

[4] For more information, please visit the website hosted by The U.S. Climate Change Science Program, at: www.climatescience.gov/Library/sap/sap4-1/default.htm, 14 August 2006.
[5] Ibid.
[6] Climate Change and Adaptation Strategies for Human Health, www.who.dk/ccashh, 5 October 2006.

precipitation and change in mean temperatures will undoubtedly be different from Salt Lake City's or Atlanta's. The impacts on agricultural areas will be different from what will challenge an urban area. Again, city governments will frequently be working with county, state and federal agencies to address these issues. The following information can provide city governments with a general understanding of potential impacts on precipitation levels and water supplies that climate change can impose.

Changes in Precipitation, Water Supply and Water Quality

Changes in weather patterns, snow cover, ice and precipitation are likely results of a warming climate. Examples of these include a more active hydrological cycle with more heavy precipitation events and shifts in precipitation in some regions while others enter prolonged droughts. There is already widespread retreat of non-polar glaciers, increases in ocean-heat levels and decreases in snow cover, sea-ice extent and thickness. For instance, it is very likely that 20th century warming has contributed significantly to the current observed sea-level rise, through thermal expansion of seawater and widespread loss of land ice.[7]

Among the expected impacts of climate changes on water resources are higher global and regional water temperatures, increases in global average precipitation and evaporation, changes in the regional patterns of rainfall, snowfall and snowmelt, changes in the intensity, severity and timing of major storms and a wide range of other geophysical effects. These changes will also have many secondary impacts on freshwater resources, altering both the demand and supply of water and changing its quality.[8]

Evaporation of water from land and water surfaces will increase as global and regional temperatures rise. More evaporation will result in more precipitation on average, though regional precipitation patterns will continue to be very complex and variable. Reviews of state-of-the-art climate models suggest that *global average evaporation and precipitation may increase by 3 to 15%* from an equivalent doubling of atmospheric CO_2 concentration. The greater the warming, the larger these increase.[9]

One of the most important hydrologic impacts of climatic change will be snowfall and snowmelt changes in high altitude watersheds or areas with strong snowmelt runoff characteristics. In these watersheds, changes in temperature are expected to lead to important changes in water availability and quality and complicate the management of reservoirs and irrigation systems.

The Intergovernmental Panel on Climate Change (IPCC) stated "freshwater resources in many regions of the world are likely to be significantly affected," and that many current freshwater problems will be made worse by the greenhouse effect. They urge water managers to begin "a systematic reexamination of engineering design criteria, operating rules, contingency plans, and water allocation policies." The report states with "high confidence" that "water demand management and institutional adaptation are the primary components for increasing system flexibility to meet uncertainties of climate change."[10] This emphasis on demand management rather than construction of new facilities marks a change in traditional water management approaches, which in the past have relied on the construction of large and expensive supply infrastructure.

Water demand-side management (DSM), is the water equivalent of energy efficiency: cheaper, faster

[7] "Climate Change 2001: Synthesis Report Summary for Policymakers," An Assessment of the Intergovernmental Panel on Climate Change, at website, www.ipcc.ch/pub/un/syreng/spm.pdf, also archived at, www.natcapsolutions.org/Cities/Chapter5/Adapting/spm.pdf, 5 October 2006.

[8] "Water Planning and Management Under Climate Change," Peter H. Gleick, Co-Founder and President of the Pacific Institute for Studies in Development, Environment, and Security in Oakland, California, www.ucowr.siu.edu/updates/pdf/V112_A5.pdf, also archived at, www.natcapsolutions.org/Cities/Chapter5/Adapting.pdf, 14 August 2006.

[9] Ibid.

[10] For more technical reports on climate change and water resources, biodiversity, etc., visit the IPCC website at: www.ipcc.ch/pub/techrep.htm, 14 August 2006.

and clearly the first option to be pursued. It reduces demand for water by increasing the efficiency of water services, and water conservation (which conserves water by decreasing its use). These are not new ideas. Cities and water districts in the western U.S. have had water conservation programs for many years, targeting both residential users and commercial/agricultural customers. For example, in 1989, Goleta, California, faced drought and the threat of a multi-million-dollar expenditure to meet EPA sewage-treatment standards. This spurred a $1.5-million municipal program that provided information and incentives to the town's 74,000 citizens to reduce water waste. More than 17,000 ultra-low-flow toilets were installed in a few years. The utility gave away 35,000 high-performance showerheads, reformed its tariff structures, made metering universal, raised public awareness and knowledge and offered free onsite surveys of outdoor water-efficiency opportunities. These technical improvements, plus some emergency drought measures (peak-season surcharges and a little rationing), cut citywide water consumption within a single year, 1989–90, by 30%, from an average of 135 to 90 gallons per person per day—twice the targeted savings. Sewage flow fell by over 40%, enabling the existing plant to run within its rated capacity and EPA secondary standards. The proposed plant expansion was indefinitely deferred. Total water savings later grew to 40 percent. In the drought of 1990, while some nearby communities were forced to cut their water use by 30–45%, Goleta had only to reduce 15%, avoiding disruption or hardship.[11]

In 1994, Mayor Martin J. Chavez and the Albuquerque City Council called for a 30% reduction in water use over 10 years. The response by city water customers was strong, with per person usage dropping from 250 gallons per capita per day when the program began in 1995, to 174 by the end of 2005. Per household analysis in 2004 shows a reduction of 34% compared to the baseline use in 1995. Residential customers, who represent approximately 50% of all water use, have reduced their usage by 39% since the program began. Institutional customers, whose numbers are much smaller, have achieved similar results. Commercial and industrial customers are being urged to respond accordingly.[12]

Some features of the program in Albuquerque include:

Offering rebates for low flow toilets (the largest source of water use in most American homes);

Offering free low flow shower heads;

Offering free public courses on Xeriscape (low water/draught resistant) gardening techniques; and

Offering rebates for high-efficiency washing machines (high-efficiency washers use approximately 25 gallons per load versus 40 to 50 gallons per load)

In the event of a longer drought period, communities would need more aggressive action plans for water DSM and conservation. Large cities and agricultural areas will adopt different strategies for functioning under extended drought conditions, including looking for new suppliers, developing new supplies, and deepening wells on the supply-side. As climactic regimes shift, it is likely that agriculture will shift as well, and crops that may have predominated in an area will no longer be grown.

New Mexico State University provides a very comprehensive, on-line template for community–scale drought emergency planning.[13]

This template assists water officials to plan for four different phases of an action agenda:

Drought alert;

Conservation;

Restrictions; and

Emergency.

In worst-case scenarios, some cities may have to limit water usage, in both residential and commercial/agriculture sectors. This could raise the price of food,

[11] Hawken, Lovins and Lovins, Natural Capitalism, P. 231, Little Brown, NY, 1999.
[12] City of Albuquerque, www.cabq.gov/waterconservation, 13 August 2006.
[13] "Action Plan for Emergency Drought Management: Short-term Strategy," New Mexico State University, website, weather.nmsu.edu/drought/action-plan/index.htm, 13 August 2006.

and cause unemployment in farming and ranching communities.

Emergency Response to Floods

In addition to conserving water during or in anticipation of drought periods, many cities must also address the other important water-related impact of climate change: increased precipitation. Increased evaporation will beget more cloud cover, which will deliver more frequent rain and snow storms in different regions. Rain patterns could greatly differ from year to year across the U.S.

Many cities already have flood action plans. The breaking of the Corp of Engineers' levees in New Orleans under hurricane Katrina has precipitated much discussion about national preparedness for storm surges. The Center for Disease Control (CDC) provides an online tool describing preparations individual households can make in the event of flood conditions to which cities can refer their citizens. The CDC manual provides information on keeping food and water safe, sanitation, re-entering the home, electrical hazards, etc.[14] Cities that do not have flood or drought action plans can get assistance from the Corps of Engineers. The Corps can provide many different types of assistance under the Flood Control and Coastal Emergency Act (Public Law 84-99), the National Emergency Preparedness Program (NEPP) and the Federal Response Plan and can provide planning assistance to cities.

The Department of Homeland Security has a new program called Citizen Corps. It hopes to recruit volunteers to be trained for emergency response in situations such as floods, ice storms, power outages, and extreme heat. Cities can leverage this federal program as well to help residents prepare for extreme conditions.[15]

Increased Insect Reproduction Rate

With warmer weather and more moist conditions in some parts of the country, another potential issue is increased insect reproduction rates and a greater distribution of vector-borne disease, such as malaria, dengue fever and Lyme disease.[16] Most cities or counties have pest management programs in place governing both agriculture and urban settings. These programs may have to be strengthened in, some regions as climate change produces conditions for faster reproduction of mosquitoes and other disease-carrying insects.

The U.S. Department of Agriculture has developed the "Integrated Pest Management (IPM) Road Map."[17] The goal of the IPM Road Map is to increase nationwide communication and efficiency through information exchanges among federal and non-federal IPM practitioners and service providers including land managers, growers, structural pest managers and public and wildlife health officials.

At the Federal level, the IPM program is a multi-agency effort that demands coordination and collaboration. The Federal IPM Coordinating Committee provides oversight of the federally funded programs. This committee is made up of representatives of the major participating Federal agencies and departments. The USDA IPM Coordinator is responsible for preparing an annual report documenting the status and performance of the IPM program nationally and distributing the report to Congress, Federal and State IPM partners, and the general public.

USDA Regional IPM Centers play a major role in gathering information concerning the status of IPM, and in the development and implementation of an adaptable and responsive National IPM Road Map. These Centers have a broad, coordinating role for IPM and they invest resources to enhance the development and adoption of IPM practices at the level of cities and local government.

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[14] CDC online tool, www.bt.cdc.gov/disasters/floods/, 14 August 2006.
[15] For more information, see Department of Homeland Security website: www.citizencorps.gov/, 14 August 2006.
[16] World Health Organization 2000 Bulletin, whqlibdoc.who.int/bulletin/2000/Number%209/78(9)1136-1147.pdf, also archived at, www.natcapsolutions.org/ClimateManual/Cities/Chapter5/Adapting/WHO_vectorborne_2000.pdf, 5 December 2006.
[17] National Road Map For Integrated Pest Management, May 17, 2004, no author name. Website: www.ipmcenters.org/IPMRoadMap.pdf, 20 August 2006, also archived at, www.natcapsolutions.org/Cities/Chapter5/Adapting/IPMRoadMap.pdf, 30 October 2006.

Increased Human Health Impacts

A study, by scientists at the World Health Organization (WHO) and the London School of Hygiene and Tropical Medicine, determined that 160,000 people already die every year from the effects of climate change, from malaria to malnutrition, children in developing nations seemingly the most vulnerable. The study projected that these numbers could almost double by 2020.[18] [19]

As described in Chapter Two, human health impacts may increase in the U.S. from global warming in a number of ways:

Fatigue, sickness, dehydration or inability to leave the home during periods of extreme heat;

Inability to leave the home during periods of extreme cold weather to buy food or get medical treatment;

More SO_2, NOx, ground-level ozone and airborne particulate matter due to increased need to operate coal-fired power plants during periods of extreme heat;

Damage to lungs from increased forest fires;

Power outages during summer peak loads, leading to spoilage of food, spoilage of medicine, interruption of medical equipment in the home or inability to pump water, and

Increased disease from vector-borne diseases.

Managing all of these potential health impacts will challenge city governments, along with county, state and federal agencies. These impacts will likely afflict the sick and elderly more than younger or healthy people, but all ages are vulnerable.

The health impacts from heat waves have already been felt in many parts of the U.S. and Europe. For example, over 100 people died in California alone during July 2006 from heat-related deaths, a marked increase over previous years. In areas extreme heat has not previously been a problem, many people do not have air conditioners for their homes. Those that do may not be able to operate them when heat waves coincide with power outages, a confluence of events that is becoming more common.

Cities, working with county, state and federal agencies, are developing emergency protocol to address these challenging and varied problems. In the heat wave of 2006, a number of cities offered central "Cooling Centers" for people trying to survive extreme heat. For example, hundreds of Cooling Centers were set-up in cities across America, including Baltimore (11 centers), St. Louis (60), Chicago (100), and New York (over 300). Boston and Chicago has free air-conditioned shuttle bus services to transport vulnerable populations to Cooling Centers, situated in community centers, police stations, libraries, park facilities and other locations.

Telephone hotlines, with up to date and accurate information on heat resources and medical advice were used in Chicago, Philadelphia and Boston. Chicago even had reverse 911 calls, automatically sent to seniors and those at risk. Some cities (Philadelphia, Baltimore and New York) went a step further and sent outreach workers to check on the homeless and elderly, providing water and fans. Chicago deployed air-conditioned buses to points around the city while Baltimore, St. Louis, Omaha and others helped provide and install air conditioners to those in need.

The city of West Palm Beach Mayor Lois J. Frankel announced that the city would extending the hours of its swimming pools to help residents and visitors beat the record-setting heat in summer. The city waived the fee to use the Warren Hawkins Aquatic Center at Gaines Park and extended pool hours.[20]Cities may have to work with clinics, hospitals and health-care providers to transport important medicines to disabled, frail or otherwise ill people trapped in their homes during periods of extreme heat or cold.

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[18] Planet Ark, www.planetark.org/dailynewsstory.cfm/newsid/22420/story.htm, 15 October 2006.
[19] WHO, www.who.int/globalchange/climate/en/ccSCREEN.pdf, also archived at, www.natcapsolutions.org/Cities/Chapter5/Adapting/ccSCREEN.pdf, 15 October 2006.
[20] City of West Palm Beach, www.wpb.org/News/showStory.php?link=06-07-31CityTakingActiontoHelpPeopleDealwithExtremeHeat.php, 14 August 2006.

CASE STUDY: Philadelphia, PA

The city of Philadelphia began taking steps to reduce the public health threat from excessive heat in 1993.[21] The cornerstone of the city's response plan is its Heat Health Watch-Warning System (HHWWS). Under the HHWWS, city staff works with the National Weather Service to determine when a heat wave is imminent.

Once a heat alert is issued, the Philadelphia Health Department contacts news organizations with tips on how vulnerable individuals can protect themselves. People who do not have air conditioning are advised to seek relief from the heat in shopping malls, senior centers and other air-conditioned spaces.

In addition, the city's 6,300 "block captains" are notified and asked to check on elderly neighbors. Block captains are individuals appointed by the city to assist vulnerable residents in their neighborhood. The Public Health Department also takes the lead on activating a number of special summer heat responses, including:

Home-visits by field teams;

Activation of the Philadelphia Corporation for Aging's "Heatline;"

Enhanced daytime outreach for the homeless; and

A "Buddy System"

The Heatline initiative is a telephone-based service where nurses are standing by to assist callers who may be experiencing health problems. If callers are deemed at-risk, mobile units are dispatched to that individual's residence. The Buddy System is a city-sponsored outreach effort that encourages the public to visit older friends, relatives and neighbors during excessive heat events.

Buddy systems may have to be deployed in many U.S. cities to save lives during power outages and extreme weather conditions to transport high-risk people to cooler or warmer places or to deliver food, water or medicine.

[21] From EPA website, www.epa.gov/heatisland/about/heatresponseprograms.html, 12 August 2006.

CASE STUDY: Chicago, IL

Chicago's Action Plan for Extreme Weather Conditions[22]

In the event that an extreme weather emergency is declared in Chicago:

The Department of Human Services operates 24-hour cooling centers and provides transportation;

The Department on Aging's senior centers have extended hours;

The Mayor's Office for People with Disabilities contacts more than 100 disability advocacy organizations, asking them to check on the health and safety of their clients;

Staff from the Department of Human Services, Department on Aging, and the Chicago Housing Authority visits at-risk residents in their homes and telephones others to ensure they are well;

The Department of Public Health monitors nursing homes and hospital emergency rooms, and deploys mobile assessment teams of nurses;

The Department of Water Management closely observes water pressure around the city and shuts off illegally opened fire hydrants;

The Department of Buildings inspects high-risk buildings to ensure that windows are open and ventilation systems are functioning;

Extra tow trucks from the Department of Streets and Sanitation are made available to assist stranded motorists;

The Chicago Public Schools limits students' strenuous activities and modifies dress codes; and

The Extreme Weather Notification System places automatic telephone calls to at-risk individuals in advance of a heat wave or severe cold (the calls consist of a recorded message of weather forecasts, safety tips and information on city services).

CONTACT

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oemc@cityofchicago.org

[22] For more information about Chicago's and other cities' emergency action plans, please see EPA's website at: www.epa.gov/heatisland/about/heatresponseprograms.html, 12 August 2006.

[23] The Office of Emergency Management and Communications website, egov.cityofchicago.org/city/webportal/portalEntityHomeAction.do?BV_SessionID=@@@@0043648670.1166219364@@@@&BV_EngineID=ccceaddjjdgjhijcefecelldffhdfgm.0&entityName=Emergency+Communications&entityNameEnumValue=12, 5 December 2006.

Additional Resources

California Climate Change Center: In 2003, the California Energy Commission, through its Public Interest Energy Research program, established the California Climate Change Center to undertake a broad program of scientific and economic research on climate change in California. The Center is organized as a "virtual" institution with sites at both the UC Berkeley campus and the Scripps Institute of Oceanography (UC San Diego campus). The Berkeley Center, based at the Richard & Rhoda Goldman School of Public Policy, is focusing on economic and policy analysis, while the Scripps Center focuses on physical climate modeling. www.climatechange.ca.gov/research/index.html

"**Climate Change 2001: Impacts, Adaptation and Vulnerability**." International Panel on Climate Change. www.ipcc.ch/

"**Coping with Global Climate Change: The Role of Adaptation in the United States**". Prepared for the Pew Center on Global Climate Change, June 2004 www.pewclimate.org/global-warming-in depth/all_reports/adaptation/index.cfm

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