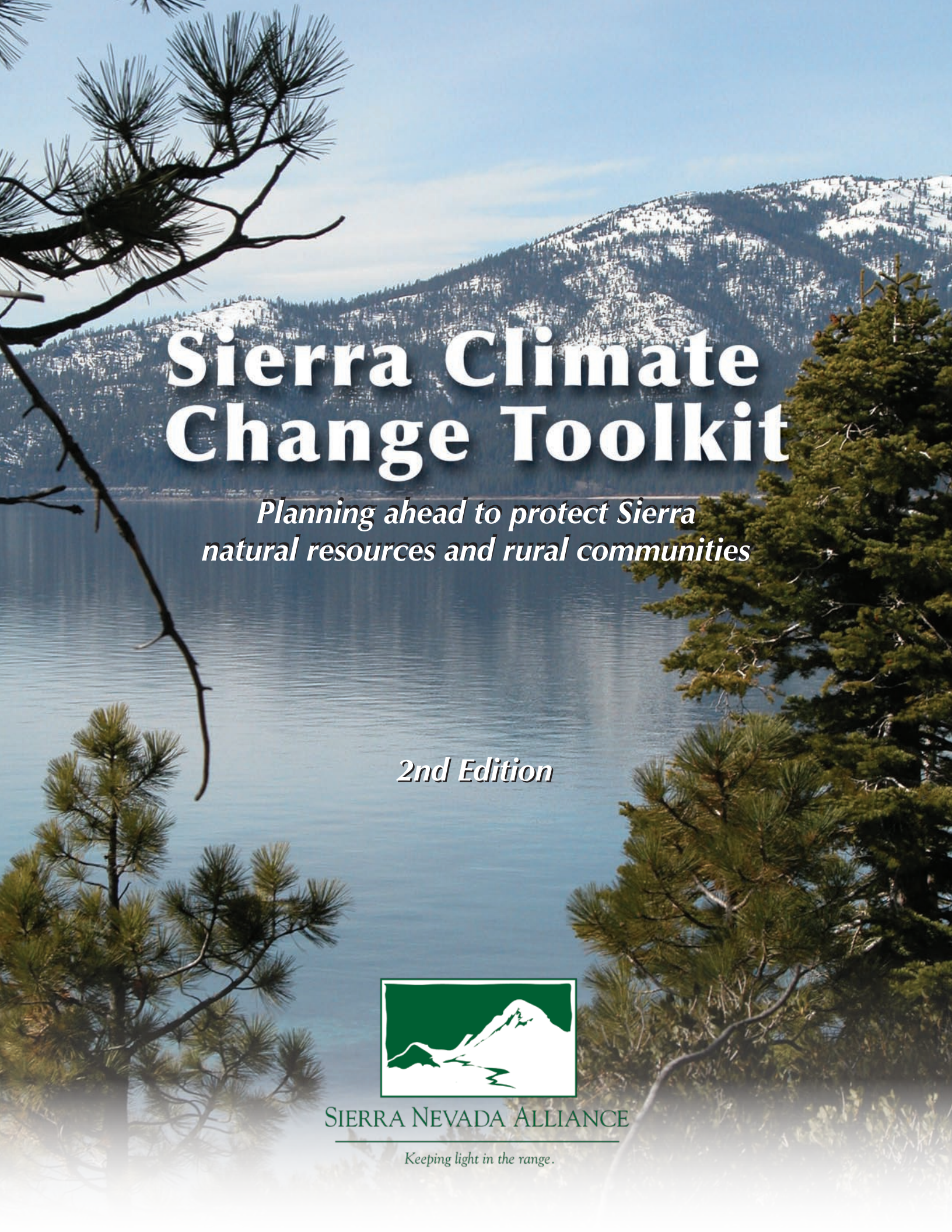

Sierra Climate Change Toolkit

Planning ahead to protect Sierra natural resources and rural communities

2nd Edition

SIERRA NEVADA ALLIANCE

Keeping light in the range.

Acknowledgements

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The authors bear responsibility for any factual errors. Recommendations and views expressed are those of the Sierra Nevada Alliance and do not necessarily represent those of funders, reviewers or others who offered assistance to this report.

Sierra Nevada Alliance

The Sierra Nevada Alliance has been protecting and restoring Sierra land, water, wildlife and communities since 1993. The Alliance unites hundreds of individuals and conservation groups to protect Sierra resources.

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Chapter 1: Introduction

Climate scientists agree that the world's climate is changing. The effects of global climate change will pose many challenges to the environment, economies, and communities of both California and Nevada over the coming decades. For example, by mid-century spring snowpack in the Sierra Nevada is projected to decline by 25 to 40 percent. Toward the end of the century, losses could reach 75 to 90 percent. The depletion of snowpack is alarming because the Sierra Nevada is home to 24 major watersheds that provide up to 65% of California's developed water supply and almost all of Northern Nevada's.

Climate Change is One of the Greatest Challenges the Sierra Faces

The Sierra Nevada Alliance's mission is to protect and restore the natural environment of the Sierra Nevada for future generations, while ensuring healthy and sustainable communities. We developed the "Climate Change Toolkit" to help community leaders throughout the region understand the basic science of climate change, how climate change affects the Sierra, and how we can work together to plan ahead and protect natural resources in the face of significant change. The Sierra Nevada Alliance believes climate change is the greatest challenge the Sierra faces in protecting the diversity and beauty of our natural environment as well as our vibrant rural economies. At the same time, we believe conservation and community leaders are the individuals who can take the lead in meeting the challenges of climate change.

Planning How to Adapt Now is Easier & Cheaper

Currently, there are hundreds of resource planning processes at work in the Sierra that will carry us into the future, but almost none are taking climate change into account. Planning how to adapt to climate change now will be easier and cheaper than waiting for a crisis and will allow us to come up with win-win solutions that protect our natural resources and our local economies.

Adaption is the Focus of this Toolkit

A review of other organizations' efforts to focus on climate change has shown that almost all groups are focusing on reducing greenhouse gases. While we touch briefly on this critical topic, the focus of this Toolkit is to explain how our communities can plan ahead for the changes that are going to occur. Even under the best emission reduction scenarios, very significant changes in climate are predicted. Adapting to such change is critical.

SIERRA NEVADA ALLIANCE

Founded in 1993, the Sierra Nevada Alliance unites hundreds of individuals and conservation groups to protect Sierra resources. We are driven by a vision of a Sierra where natural and human communities coexist in harmony. A Sierra where residents and visitors alike understand and value the unique qualities of the range and protect the places they love. For more information on the Sierra Nevada Alliance's efforts to build the capacity of individual conservation groups, a list of our member groups, our region-wide campaigns, and the organization visit our website at: www.sierranevadaalliance.org

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Adaptation for Changes Occurring Under Greenhouse Gas Reduction

It is important to note that the Alliance has designed this toolkit based upon scenarios for future climate change. These scenarios assume that in the near future measures will be adopted that will reduce greenhouse gases. If we don't act quickly to reduce greenhouse gases and prepare for the unavoidable consequences of climate change, the future could look far bleaker than the one described in this toolkit. By procrastinating, we make the process of adapting our current resource management strategies tremendously difficult, if not impossible.

Whether you are involved in a long-term river restoration project, a General Plan update, a dam relicensing, a large-scale reforestation effort, or any other sort of resource management planning, this toolkit will enable you to include climate change impacts in your discussions and planning processes. Only by acting now will we be able to protect the natural resources we love. The members of the greater Sierra community can be the leaders in transforming the way people in California and Nevada are dealing with global climate change. The State of California has taken the lead in implementing many forward-thinking measures and has funded critical research, but we need to take the lead in on-the-ground planning to ensure a healthy future for the Sierra's unique communities, ecosystems and rural character.

This toolkit will review:

- The science of climate change and impacts on the global, national and state level
- The effects of greenhouse gas emissions and actions you can take to reduce them
- Information about climate change impacts and specific actions to plan ahead for:
    - A. Water & Watershed Management
        1. Flood Management
        2. Dam Relicensing
        3. Watershed & Fisheries: Assessment, Protection, and Restoration
        4. Water Supply
    - B. Species Protection
    - C. Forest Management
    - D. Wildfire Management Strategies
    - E. City & County Land Use Planning
        1. Community-Wide Land Use Impacts
        2. Site-Specific Land Use Impacts
        3. Reducing Emissions Through Better Land Use
            - i. Community-Scale Recommendations
            - ii. Site-Specific Recommendations

Also included in the Toolkit you will find a CD containing the following:

- **40 minute Adaptation Power Point:** A great learning tool for resource planners on incorporating climate change into current and future planning efforts.
- **15 minute Adaptation Power Point:** A shorter presentation that highlights key concepts for resource planners on incorporating climate change into current and future planning efforts.
- **40 minute Individual Emission Reduction Power Point:** A presentation on climate change impacts at the global to Sierra level and how to minimize your ecological footprint to reduce greenhouse gases.
- **15 minute Individual Emission Reduction Power Point:** A shorter presentation that highlights key concepts and actions on how to minimize your ecological footprint.
- **Power Point Slide Menu:** A medley of slides you can choose from to create your own educational presentations.
- **Climate Change Factsheet:** Facts on climate change impacts and predictions at the global to Sierra level.
- **Sierra to the Sea: Smart Water Path Factsheet:** Recommended strategies to adapt state water management for climate change.
- **Sierra Nevada Alliance Water & Climate Change Campaign Factsheet:** Reviews climate change and what the Sierra Nevada Alliance is doing to tackle these issues.

Chapter 2: Climate Change Impacts:

For most of us in California and Northern Nevada, the temperate and somewhat predictable seasonal climate is a major attraction. It is also the engine that dictates our water supply, food production, energy demands, ecosystem health, recreation patterns and much more. We are all accustomed to the climate's tremendous variability from year to year, but over the long-term most of us expect California and Northern Nevada's climate to maintain its average features. However, signs indicate that climate change is, indeed, underway. As a result, we are going to have to change the way we view our climate and how we manage our natural resources.

The consequences of climate change are projected to be substantial in a number of California and Nevada's temperature-sensitive sectors. For example, the higher temperatures that are predicted will reduce the snowpack in the Sierra Nevada, with serious implications for winter recreation and statewide water supplies. Sierra snow is the largest reservoir of water California and Nevada have. California and Nevada's massive water delivery systems are extremely dependent on the Sierra's snow pack, which stores water over the winter and early spring, then melts over the spring and early summer to refill water reservoirs and groundwater that supply water in the late summer and fall. When there is more precipitation falling in the form of rain during the winter, reservoirs have to let out water for flood control rather than store it. Consequently, if precipitation comes down as more rain and less snow, more water is let through the reservoir system to prevent flooding in the winter and early spring and cannot be stored for use in the summer and fall when needed.

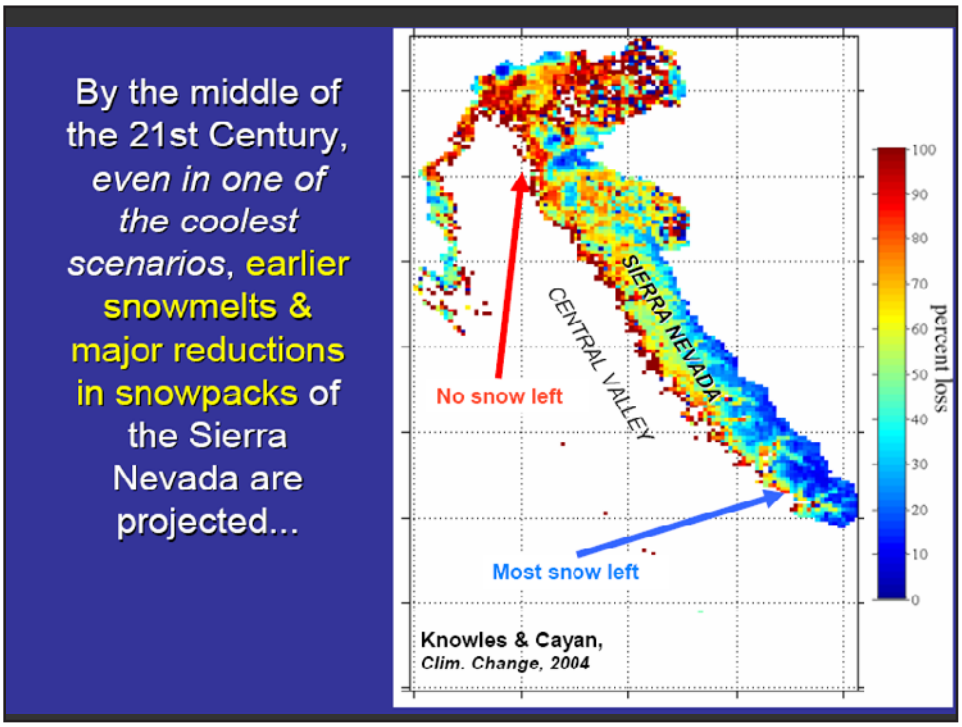


Figure 1
Source: Elevation Dependence of Projected Hydrologic Changes in the San Francisco Estuary and Watershed, N Knowles and D. Cayan, 2004

Reducing Emissions and Adapting to the Changes Already Set in Motion

More data confirms global warming is already underway. Caused by a variety of factors like natural fluctuations, fossil fuel emissions and deforestation, climate change presents a dilemma for human kind. The emerging questions basically revolve around degrees of change and predictions about how bad it's going to get, as well as what can be done (and how quickly) to minimize changes in climate.

Two must-read publications on Climate Change in California:

"How the West Will Warm" Natural Resources Defense Council
www.nrdc.org/globalWarming/gww/fgww.asp

"Our Changing Climate: Assessing the Risks to California" A summary report from the California Climate Change Center
www.climatechange.ca.gov/biennial_reports/2006report/

There are two major courses of action we must all take to provide a future that has many of the qualities for the future that we enjoy today. We must reduce greenhouse gas emissions to prevent extreme climate changes. At the same time, we must adapt to the changes that we cannot prevent – and adapt in ways that protect our communities and our natural environment and biodiversity.

There are many excellent efforts being promoted to reduce greenhouse gases and we list some of these in Chapter 3: Heat-Trapping Gases and How to Reduce Them. We also briefly review actions individuals can take to reduce greenhouse gases. However, the main purpose of this toolkit is to explore tools and tactics to implement adaptive resource management to protect the Sierra Nevada.

The financial and environmental impacts of climate change are going to be far more severe the longer we delay in taking adaptive action. By planning now and by incorporating information about climate change into decisions about how we manage our environment and our community behaviors, we can reduce the negative impacts of human-caused climate change and natural climate variability.

Changes in Arctic Sea Ice

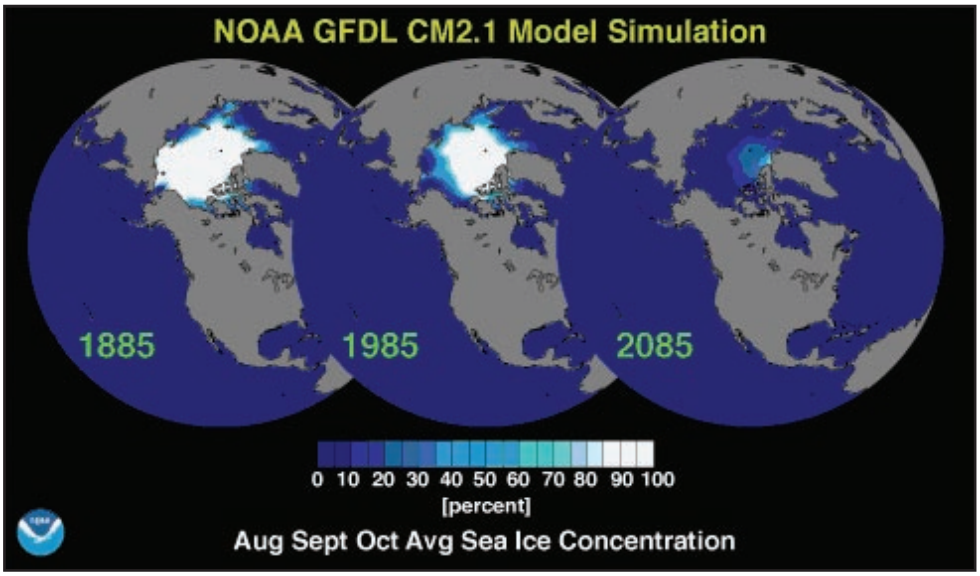


Figure 2
National Oceanic and Atmospheric Administration. "Arctic sea ice changes in gfdl climate change scenario experiments." January 11, 2007. <http://gfdl.noaa.gov/~kd/kdwebpages/NHice.html>

Climate Change at the Global Level

Rising Temperatures

- Eleven of the last 12 years (1995 –2007) rank among the 12 hottest years on record (since 1850, when sufficient worldwide temperature measurements began).[1]
- Over the last 50 years, "cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent."[2]
- On average, between 1950 and 1993, nighttime air temperature increased at about twice the rate (0.4 degrees F) of daytime temperatures.[3]

Increasingly Severe Weather (storms, precipitation, drought)

- The intensity of tropical cyclones (hurricanes) in the North Atlantic has increased over the past 30 years, which correlates with increases in tropical sea surface temperatures.[4]
- Storms with heavy precipitation have increased in frequency over most land areas. Between 1900 and 2005, long-term trends show significantly increased precipitation in eastern parts of North and South America, northern Europe, and northern and central Asia.[5]
- Between 1900 and 2005, the Sahel (the boundary zone between the Sahara desert and more fertile regions of Africa to the south), the Mediterranean, southern Africa, and parts of southern Asia have become drier, adding stress to water resources in these regions.[6]
- Droughts have become longer and more intense, and have affected larger areas since the 1970s, especially in the tropics and subtropics.[7]

Melting Snow and Ice

- Since 1900 the Northern Hemisphere has lost seven percent of the maximum area covered by seasonally frozen ground.[8]

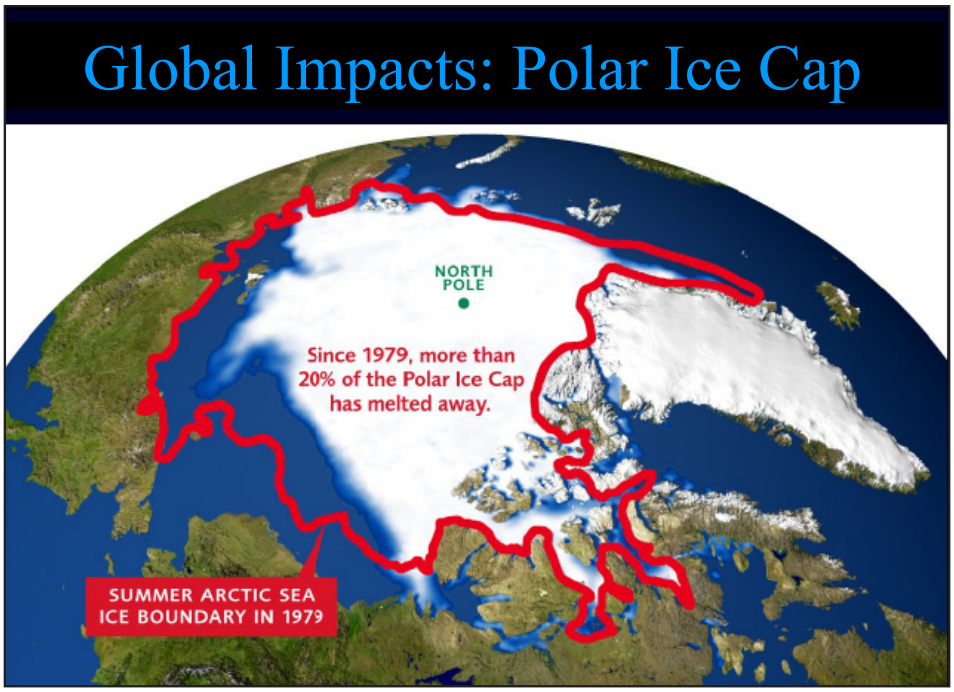


Figure 3
Source: Climate Change 2001: Synthesis Report - see Endnote [3]

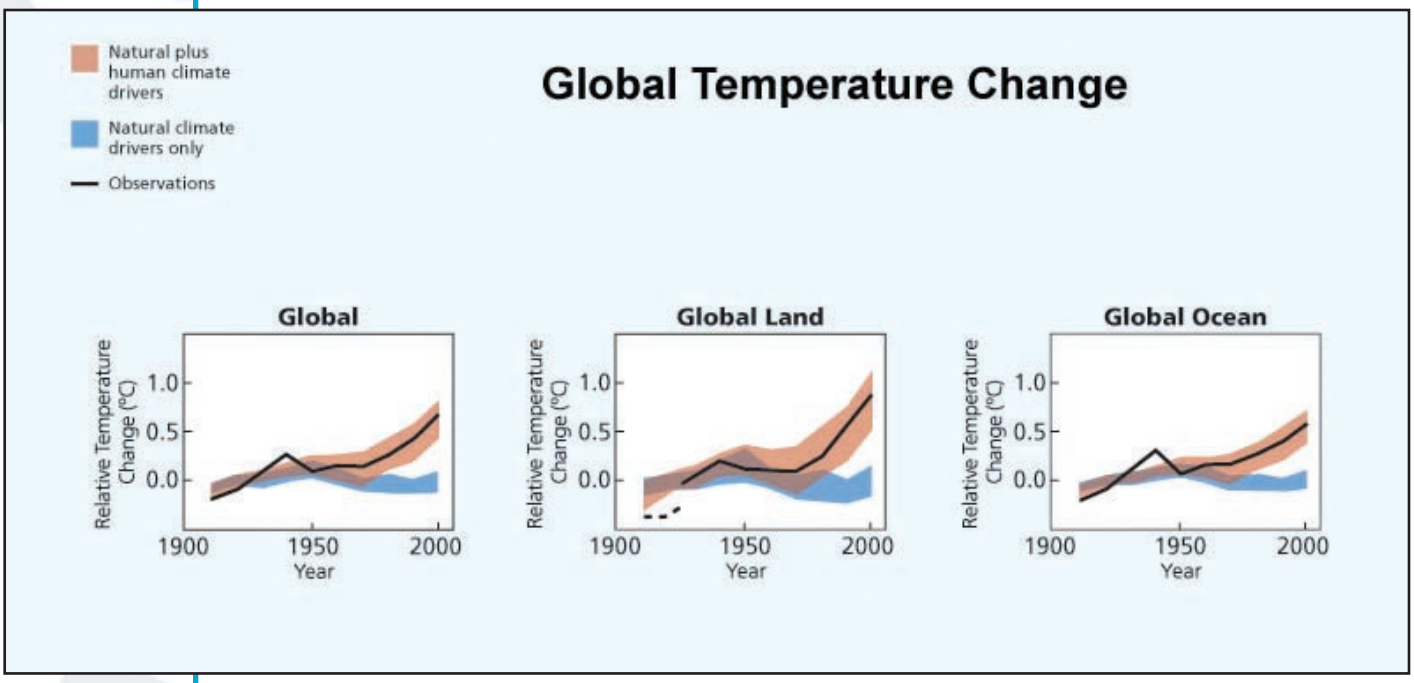


Figure 4
"Global and continental temperature change." Intergovernmental Panel on Climate Change (IPCC)- See Endnote 1.

- Snow cover in the Northern Hemisphere has decreased about 10% since the late 1960's.[9]
- Satellite data since 1978 shows that the extent of Arctic sea ice during the summer has shrunk by more than 20 percent.[10]
- There has been a reduction of about two weeks in the annual duration of lake and river ice cover in the middle to high latitudes of the Northern Hemisphere in the last 100 years.[11]

Rising Sea Levels

- Since 1961, the world's oceans have been absorbing more than 80 percent of the heat added to the climate, causing ocean water to expand and contributing to rising sea levels. Between 1993 and 2003 ocean expansion was the largest contributor to sea level rise.[12]
- Melting glaciers and losses from the Greenland and Antarctic ice sheets have also contributed to recent sea level rise.[13]
- Thermal expansion has already raised the oceans 4 to 8 inches.[14]
- The IPCC estimates that the global average sea level will rise between 0.3 and 2.9 feet (0.09 to 0.88 meters) in the next century.[15]

Moving Wildlife

- Data collected on the effects of climate change on more than 1,500 plant and animal species around the globe show that half of those species have clearly shifted upward or northward in recent decades.[16]
- 2/3 of animal species are breeding earlier in the year. Only a handful are moving to warmer climates, or breeding later.[17]

Climate Change at the National and North American Level

Rising Temperatures

- The first eight months of 2006 were the warmest in the continental United States since record-keeping began in 1895.[18]
- U.S. and global annual temperatures are now approximately 1 degree Fahrenheit warmer than at the start of the 20th century, according to NOAA.[19]
- The rate of warming has accelerated over the past 30 years, increasing globally since the mid-1970s at a rate approximately three times faster than the trend as seen over the entire past century.[20]
- The past nine years have all been among the 25 warmest years on record for the contiguous United States.[21]
- Examination of spring seasons across North America over the period from 1900-1997 – using modeling and actual lilac phenological data – showed an average 5-6 day advance toward earlier spring seasons, over a 35-year period from 1959-1993.[22]

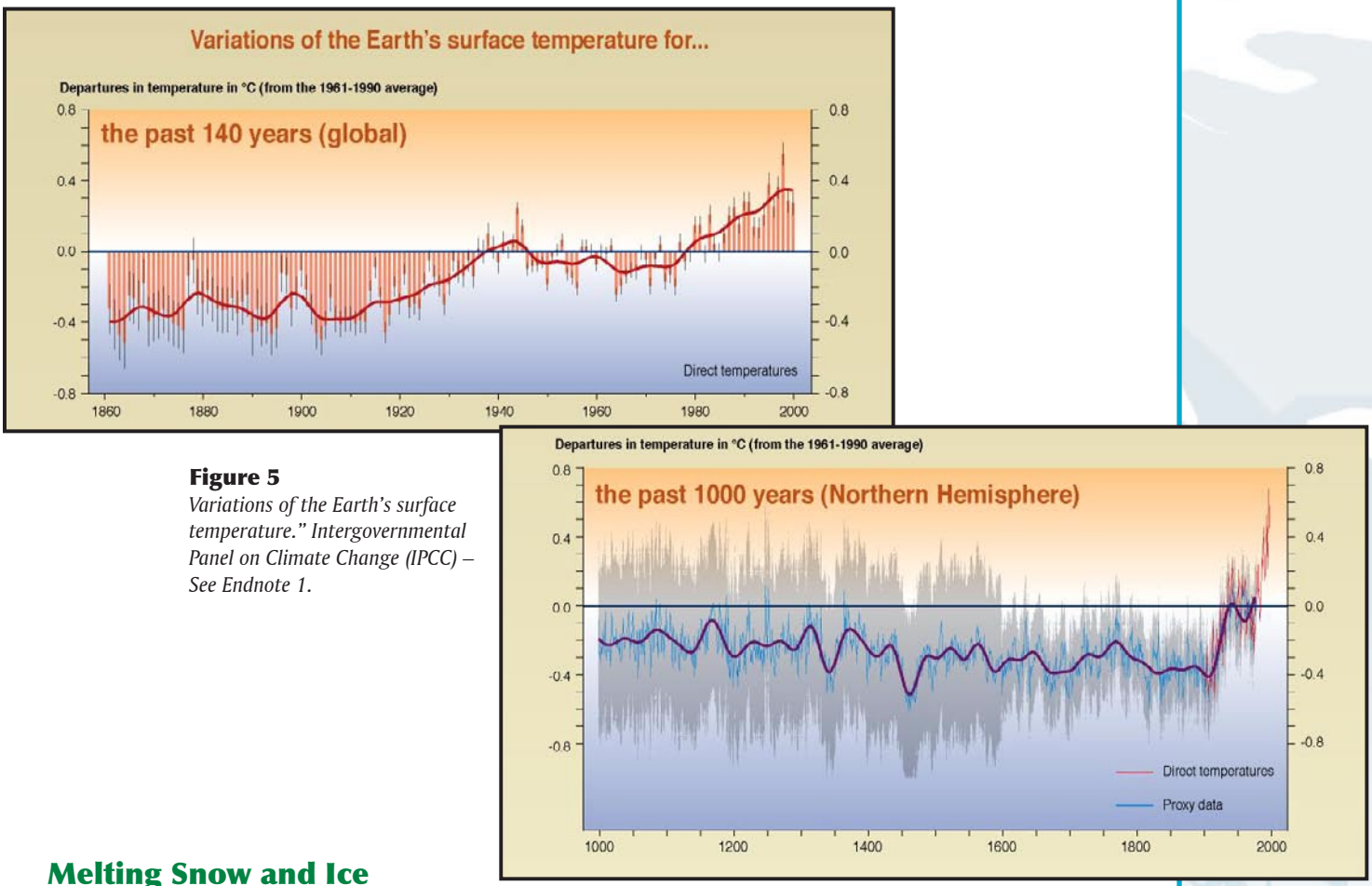


Figure 5
Variations of the Earth's surface temperature." Intergovernmental Panel on Climate Change (IPCC) – See Endnote 1.

Melting Snow and Ice

- When Glacier National Park was established in 1910, it contained 150 glaciers. Currently there are only 30 glaciers left at about 1/3 their original size.[23]
- A study of 67 glaciers in Alaska shows that in the 40 years from the mid-1950s to the mid-1990s, these glaciers thinned by an average of about 1.6 feet per year. Repeat measurements on 28 of these glaciers show that from the mid-1990s to 2000-2001, the rate of thinning had increased to nearly 6 feet per year.[24]

- The freeze-free (growing) season in many middle to high latitude regions in the northeastern United States has become 11 days longer since 1950.[25]

Rising Sea Levels

- Sea level has been rising 0.08-0.12 inches per year (2.0-3.0 mm per year) along most of the U.S. Atlantic and Gulf coasts.[26]

Moving wildlife

- The red fox of northern Canada moved its range 600 miles northward in just 30 years.[27]
- Five species of tropical butterflies have just been recorded in Texas, and some are trying to breed as far north as Austin—about 700 miles north of their usual range.[28]

In the Sierra Nevada, seven of the largest glaciers (Dana, Lyell, Kneiss, Maclure, Mendel, Darwin, & Goddard) have retreated 30-70% in the past 100 years.

Climate Change at the State and Regional Level

In an article published in The Proceedings of the National Academy of Sciences (101:34, 2004), a consortium of scientists revealed their findings comparing two different climate scenarios for California. The study used two of the latest-generation global climate models and lower-and higher-emissions scenarios to predict climate change impacts in California. The lower emissions scenario relies on a transition to cleaner energy technologies, causing emissions to peak by mid-century and then decline below current levels by 2100.

Figure 6
Lyell Glacier images-taken from Greg Stock's power point presentation: "Melt Down: The Rise and Recent Fall of Sierra Nevada Glaciers." – Listed in Chapter 6

Rising Temperatures

- By mid-century, average summer temperatures are projected to rise about 2 to 4 degrees Fahrenheit. Toward the end of the century, average summer temperatures are projected to increase from 4 to 8.5 degrees Fahrenheit.[29]
- Average winter temperatures are projected to rise about 2 to 2.5 degrees Fahrenheit by mid-century and by the end of the century average winter temperatures are projected to rise roughly 4 degrees Fahrenheit.[30]
- The average annual temperature will rise to 69 degrees from 59 degrees.[31]

Increasingly Severe Weather and Events

- The heat wave season—the period during which temperatures reach 90 degrees or higher for three or more consecutive days—lengthens to between 132 days a year and 204 days a year. Historically, the heat-wave season has lasted only 115 days.[32]
- Heat-related deaths in Los Angeles will jump from 165 to 1,182 a year.[33]
- From 1987-2003 there was a fourfold increase in wildfires from the preceding 16 years. Those fires also burned 6.5 times more land.[34]
- From 1987-2003 the average fire duration increased from 7.8 to 37 days and the average fire season grew by an average of 78 days.[35]

Melting Snow and Ice

- Earlier snowpack melting in the Sierra Nevada has resulted in some year-round mountain streams going dry by summer and creating 12% less spring and summer snowmelt in the Sacramento River than 100 years ago.[36]
- The fraction of annual runoff from the central Sierra that occurs in late spring has been decreasing for approximately the past 50 years. More of the annual runoff has occurred in the winter.[37]
- Winter and spring temperatures have become warmer in the central Sierra. By mid-century, spring snowpack in the Sierra Nevada is projected to decline about 25 to 40 percent. Toward the end of the century, losses could reach 30 to 70 percent.[38]
- By 2050, a combination of delayed snow accumulation and earlier snowmelt could shorten the Sierra Nevada ski season by three to six weeks. By the end of the century, the ski season could be shortened by 7 to 15 weeks.[39]
- In most cases, total annual streamflow into major Sierra Nevada reservoirs is projected to drop about 10 to 20 percent before mid-century and 25 to 30 percent before the end of the century.[40]

Leading Scientists Predicting Significant Changes in California

"Emissions, Pathways, Climate Change and Impacts on California," a report by K.Hayhoe, ATMOS Research and Consulting; D.Cayan, Scripps Institute of Oceanography; C.B.Field, Carnegie Institution of Washington; P.C. Frunhoff, Union of Concerned Scientists; E.P.Maurer, Santa Clara University; N.L.Miller, Lawrence Berkeley National Laboratory; S.C.Moser, National Center for Atmospheric Research; S.H.Schneider, Stanford University; K.N.Cahill, Stanford University; E.E.Cleland, Stanford University; L.L.Dale, Lawrence Berkeley National Laboratory; R.Drapek, USDA Forest Service; W.M.Hanemann, University of California, Berkeley; L.S.Kalkstein, University of Delaware; J.Lenihan, USDA Forest Service; C.K.Lunch, Stanford University; R.P.Neilson, USDA Forest Service; S.C.Sheridan, Kent State University; and J.H.Verville, Union of Concerned Scientists.

See www.climatechoices.org for further information.

- As the runoff season begins earlier, spring and summer streamflow is projected to decline about 10 to 20 percent before 2050. By the end of the century, spring and summer streamflow could be reduced by as much as 40 percent.[41]
- Mountain glaciers and snow-cover have declined worldwide. In the Sierra Nevada, seven of the largest glaciers (Dana, Lyell, Kneiss, Maclure, Mendel, Darwin, and Goddard) have retreated 30 to 70 percent in the past 100 years.[42]
- Assuming that glacier retreat rates over the past few decades continue, most of the glacier in the Sierra Nevada will be "gone" (i.e., no longer functioning as moving glaciers) by 2050 according to Yosemite National Park Geologist, Greg Stock.

Moving and Disappearing Wildlife

- Pikas, a small relative of the rabbit which are native to cold climates, have disappeared from nearly 30% of areas where they were common in the Sierra Nevada. They have also retracted the lower edge of their ranges by an average of 1,700 vertical feet.[43]
- In 1915 the piñon mouse was only found below 7,000 feet in the Eastern Sierra; currently they can be found at 10,200 feet above sea level and eight miles from their range in 1915.[44]

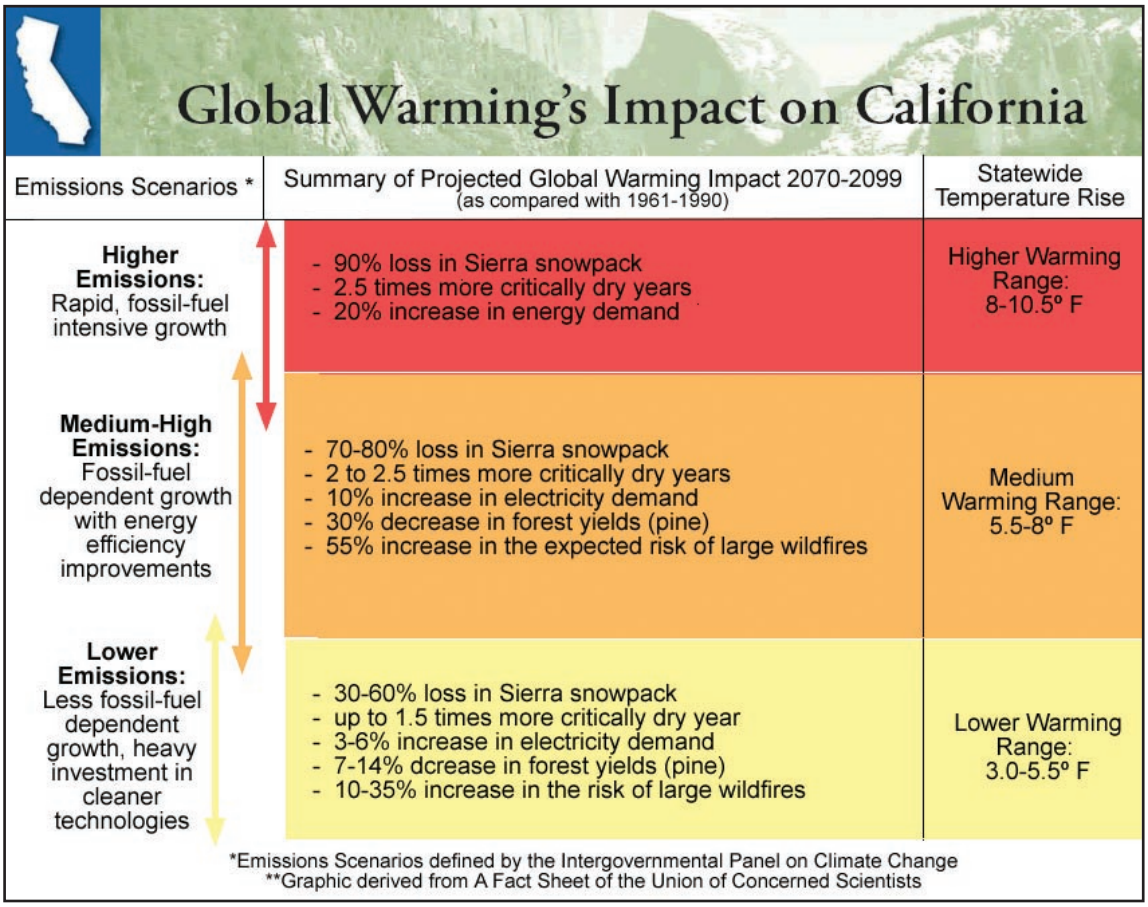


Figure 7
Union of Concerned Scientists. "Global Warming's Impact on California." <http://www.ucsusa.org/assets/documents.global_warming/ucs-ca-impacts.pdf>

Chapter 3: Heat Trapping Gases and How to Reduce Them

The debate about the causes of global warming and whether greenhouse gases are a major factor is over. There is no question that several factors such as volcanic eruptions and small changes in the Earth's orbit influence global temperature. However, when scientists look back at the whole of the last century they are unable to explain significant recorded temperature increases in terms of natural causes. It is only when the trends for human-induced heat-trapping gases and land-use changes are included that the recorded reality matches up to the models; this is especially notable when looking at the warming trend that has been occurring since 1970.

The good news is that the future is in our hands. Right now, we have the opportunity to make choices that will help prevent the worst climate change impacts from occurring.

If we are to successfully reduce emissions, action must be taken on every level. Federal, state and local governments must commit to reducing emissions. Businesses and corporations and organizations must do their part to reduce emissions.

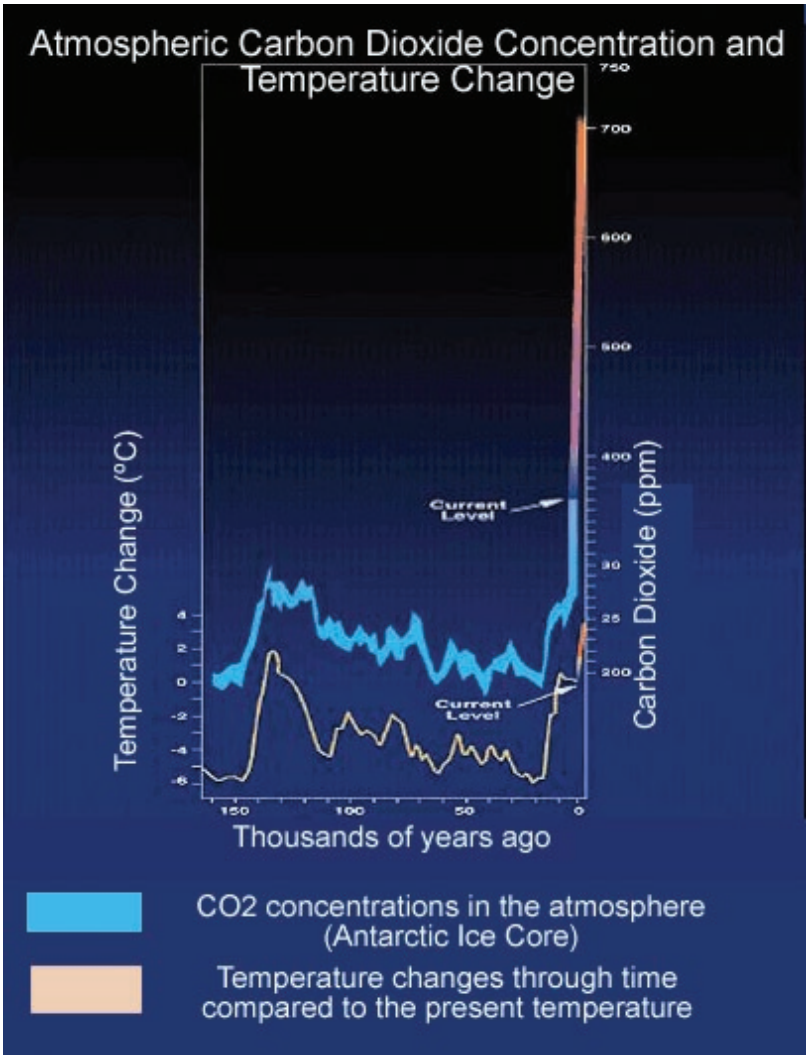


Figure 8
The White House. "Atmospheric Carbon Dioxide Concentration and Temperature Change." <http://www.whitehouse.gov/news/releases/2002/02/climatechange.html>

"I recognize that the surface of the Earth is warmer and that an increase in greenhouse gases caused by humans is contributing to the problem."
President George W. Bush
July 6, 2005
G8 Summit, Gleneagles, Scotland

According to “Emissions of Greenhouse Gases in the Unites States”, a report released by the U.S. Department of Energy, 82.4% of all greenhouse gases released were energy-related carbon dioxide. California is the tenth largest emitter of carbon dioxide in the world.

Energy Information Administration. “Emissions of Greenhouse Gases in the United States 2004.” U.S. Department of Energy. December 2005.

<ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057304.pdf>

California’s Global Warming Solutions Act of 2006

National and international actions are necessary to fully address the issue of global warming. However, action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act.

The goals of Assembly Bill 32, authored by Fabian Nuñez and Fran Pavley, are to reduce greenhouse gas emissions. Three specific targets have been set. The first aim is to reach emission levels of 2000 by 2010. The second goal is to reach 1990 levels by 2020, and lastly is to achieve 80% below 1990 levels by the year 2050.

The way these goals are to be achieved is through joint efforts from various state agencies which include but are not limited to, the State Air Resources Board, the Public Utilities Commission, and the State Energy Resources Conservation and Development Commission. The state board will also convene an environmental justice advisory committee to advise and assist in implementing provisions, as well as to ensure that activities undertaken do not disproportionately impact low-income communities.

Joint efforts will focus on developing emission reduction measures in a manner that minimizes costs and maximizes benefits for California’s economy, improves and modernizes California’s energy infrastructure and maintains electric system reliability, maximizes additional environmental and economic co-benefits for California, and complements the state’s efforts to improve air quality.

This will be achieved through regulations that the State Air Resources Board will adopt by January 2008, to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program. The state board shall also monitor compliance with and enforce any rule, regulation, order, emission limitation, and emission reduction measures; any violations are subject to penalties.

To learn more please visit:

The California Climate Change Portal

http://www.climatechange.ca.gov/documents/2006-09-27_AB32_GOV_NEWS_RELEASE.PDF

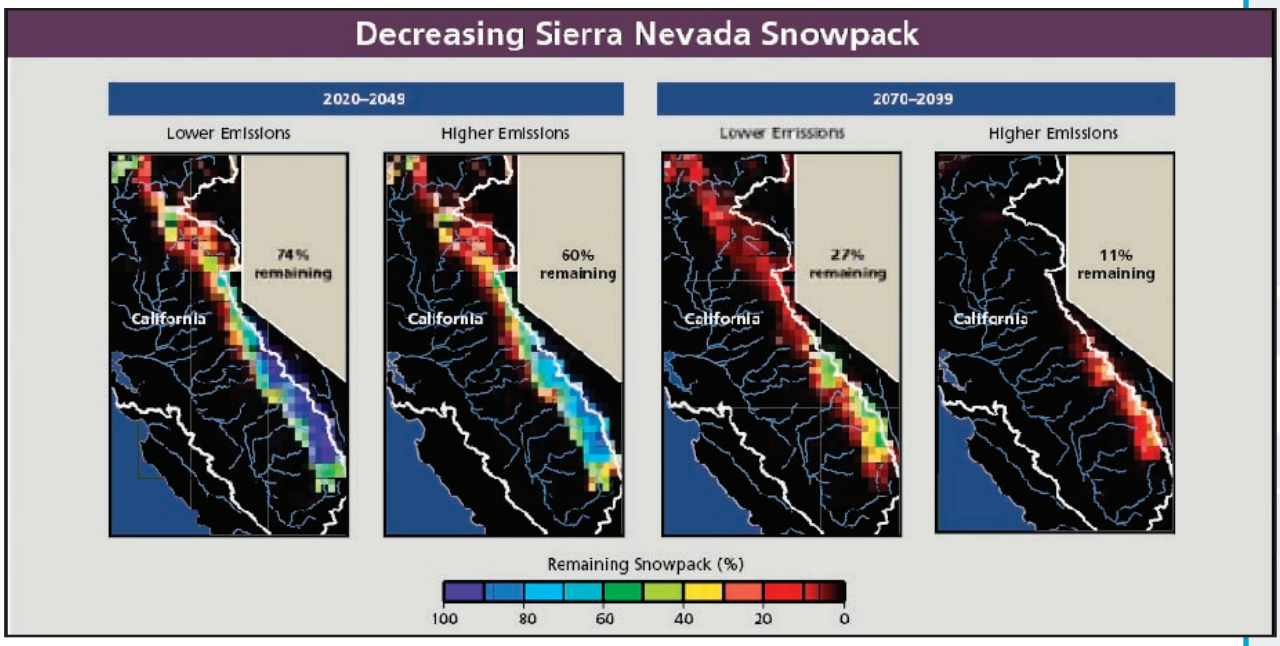


Figure 9
"Climate Change in California: Choosing Our Future," Union of Concerned Scientists.
<http://www.ucsusa.org/assets/documents/global_warming/CA_climate_summary.pdf>

Individuals must also reduce their emissions. Here is a quick summary of what actions individuals can take to reduce greenhouse gas emissions to help avoid the worst climate change impacts from occurring:

1. **Your personal transportation makes a difference.**
   - When you buy your next car choose one with the best fuel economy. See www.hybridcenter.org or www.epa.gov/greenvehicle
   - Think before you drive. Join carpools, walk, bike or use public transport whenever possible. For every mile you don't drive, you will save one pound of carbon dioxide.
   - Check your air filter monthly and keep your tires adequately inflated. Keeping your tires properly inflated can improve gas mileage by more than 3%.
2. **Plant a tree.** A single tree will absorb one ton of carbon dioxide over its lifetime.
3. **Reduce-Reuse-Recycle.** Save 1, 200 pounds of carbon dioxide by cutting your garbage by 10%.
4. **Choose clean power.** Several utility companies in California and Nevada offer power produced from renewable resources. See www.green-e.org for more details.
5. **Perform a home energy audit and reduce energy use at home.** Many utilities offer free home energy audits and various websites offer on-line audits e.g. www.hes.lbl.gov developed by the Lawrence Berkeley National Laboratory.
   - Look for the Energy Star on new appliances. www.thegreenguide.com/green_home www.pge.com/rebates/energy_tools_resources
   - Replace regular light bulbs with energy-saving models. Doing this will save 150 pounds of carbon dioxide a year.
   - Lower your water heater temperature & turn down your heating thermostat.
   - Use a fan instead of your air conditioner.
   - Wash your laundry in cold water instead of hot. This cuts energy usage for laundry by 50%.

While not preventing global warming, these actions do help prevent catastrophic warming

6. **Conserve water to conserve energy.** It takes a lot of energy to transport water to your home and more energy to heat water. By conserving water you reduce energy consumption.
   - Install low flow showerheads and toilets
   - Plant native plants and plants that require less water
   - Use drip irrigation
   - Shrink your lawn
   - Fix leaky faucets; one drip every 3 seconds wastes 30 gallons a month

7. **Think before you eat.**
   - Eat seasonal, local food that hasn't traveled as far in trucks, ships, or planes.
   - Eat organic—one-third of the energy that goes into growing food crops is used to manufacture fertilizer; organic crops don't use manufactured chemical fertilizer.
   - Consider local pasture–raised meats which aren't grown on huge farms far away. www.localharvest.org and www.buylocal.ca.org

8. **Cut office energy use.**
   - Reorganize your workspace to make the best use of natural light.
   - Install motion sensors to shut off lights when everyone leaves the room.
   - Buy Energy Star certified office equipment.
   - Turn off your computer and copier as well as power strips and surge protectors when not in use.

9. **Buy wood produced in a sustainable manner.** Learn more about certified forest products at the U.S. Forest Stewardship Council's website www.fscus.org.

10. **Consider the impacts of your investments:** If you invest your money, you should consider the impact that your investments and savings will have on global warming. You can learn more about how to ensure your money is being invested in companies, products and projects that address issues related to climate change at www.ceres.org and www.socialinvest.org.

11. **Write to your elected officials** to let them know you're concerned about climate change and to encourage aggressive greenhouse gas reduction efforts.

You can calculate how much greenhouse gas you produce every year at the following sites:

- U.S. Environmental Protection Agency: www/epa.gov/climatechange/emissionsind_calculator.html
- The official site for Al Gore's "An Inconvenient Truth": www.climatecrisis.net/takeaction/carboncalculator.html

Chapter 4:
Planning for Future Climate Change

The Sierra Nevada Alliance's mission is to protect and restore the natural environment of the Sierra Nevada for future generations while ensuring healthy and sustainable communities. The Alliance believes that climate change is one of the greatest challenges the Sierra faces in protecting the diversity and beauty of our natural environment as well as our vibrant rural economies. In the face of climate change impacts we need to plan and act now to protect the unique attributes of the Sierra–our working landscapes, rural character, recreational paradise and unique ecosystem. In order to do this we need to:

1. **Educate ourselves on impacts of climate change**
2. **Identify future change through modeling**
3. **Use adaptive management strategies**
4. **Monitor and track changes in weather, hydrology and ecosystems**
5. **Promote the resiliency of Sierra ecosystems and minimize non-climate stressors**
6. **Prioritize projects that will succeed under multiple scenarios**
7. **Integrate and coordinate local efforts**

1. Educate ourselves on impacts of Climate Change.

Educate yourself, group, agency and/or community regarding global, national, statewide, and regional impacts of climate change. The first step to addressing a problem is to understand the challenge. Don't wait—use the information in this kit to get the education process started in your group, agency or community. Do this now!

The best messengers on the impacts of climate change are scientists, water agency staff, resource agency staff, elected officials, and conservation group leaders. Use the resource section in the back of this toolkit to recruit some of these speakers to come to your organization. In the event you do not have time to recruit expert speakers, it is still worthwhile to present the information yourself. You can also invite the Sierra Nevada Alliance staff to come and present.

Once everyone in a planning forum is on the same page regarding the impacts of climate change in the Sierra, it will be easier to take the additional steps outlined below.

2. Identify future change through modeling.

Modeling and forecasting tools should be used in local processes throughout the Sierra. Forecasting in a regional context lends greater power to local articulation of climate change impacts. When people see what's going to happen in their own community it can sway them to action in ways that statements from distant scientists or politicians won't. When assessing and learning about resources in your local region, invest in modeling and forecasting of climate change impacts.

3. Use adaptive management strategies.

Because impacts of climate change are not completely known, it is essential to create plans that provide flexibility to adapt to real-world conditions in the future. Rather than striving to maintain current conditions and ecosystems, we should allow for, and assist in the adaptation of species and communities. Adaptive management does not assume that the tactics you believe are best at the beginning of a project will turn out to be the absolute best strategy over time. Adaptive management allows for ongoing assessment to adapt tactics and strategies to changing circumstances.

The concept of adaptive management has been applied for centuries under a number of different names. Physical engineers have used this approach since the first structure or bridge was constructed to continually learn from mistakes and successes and improve designs. Adaptive management has a dual nature. First, adaptive management acknowledges that we do not completely understand the system that we are dealing with. It concedes that we will proceed with a project or program using existing information while we gather the knowledge that we lack.

Second, adaptive management is a structured decision-making process that includes the following components, usually in stepwise and cyclical fashion:

- Articulate project goals, outcomes or success criteria
- Collect existing knowledge and practices relative to achieving the goals
- Identify information gaps and related research needs
- Develop a strategy and apply knowledge and relevant practices towards achieving the clear goals
- Develop a clearly-defined and defensible monitoring program to determine whether the goals are being achieved
- Negotiate a pre-defined management response if the goals are not met
- Reassess and improve practices and reconsider the goals or outcomes.

4. Monitor and track changes in weather, hydrology and ecosystems.

Ongoing monitoring and tracking of weather, hydrology, and your local ecosystem will provide the best information on the impacts of climate change. If we do not monitor the resources we are managing on a continual basis, we might not realize the changes that are occurring until it is too late in the game to successfully adapt to them. Continual monitoring is critical for adaptive management and for addressing climate changes.

5. Promote the resiliency of existing Sierra ecosystems and minimize non-climate stressors.

The likelihood that individual species or communities will be able to survive in the face of climate change will depend to a large degree on how resilient they are. Because we still don't know exactly how physical and biological change will happen in the Sierra, focusing on increasing ecosystem resilience is a far better approach than trying to plan for a specific set of predicted changes.

Climate change is not occurring in a vacuum. There are already myriad stresses on natural systems in the Sierra which will affect the capacity of these systems to adapt to climate change. Air pollution, sprawling development, increasing water demands and invasive species are examples of problems that degrade ecosystems. These stressors are also problems that we can work on now to solve. Any opportunity to reduce an existing stressor will provide more ability for ecosystems and species to handle the stress of climate change.

6. Prioritize projects that will succeed under multiple scenarios.

Because the exact nature of climate change impacts on a local level is largely unknown, it makes sense to invest in projects and strategies that will be robust enough to succeed under *multiple* future scenarios rather than a project that will only succeed under a single scenario.

7. Integrate and coordinate efforts.

Only addressing conservation on a tiny scale--when the system works on a much larger scale--tends to transfer problems, duplicate efforts, and require greater resources. Integrating and coordinating local efforts with others helps us understand the larger ecosystem and human systems. Coordinated efforts allow different entities to share resources, increase expertise, and create economies of scale. All efforts should look to network, integrate plans when possible, and collaborate on a regional and greater level.

Chapter 5:
Adapting to Climate Change

The seven-point Climate Change Platform of the previous chapter is a good generic set of principles to incorporate into any resource plan. In the Sierra Nevada Alliance's outreach with hundreds of leaders working on resource planning efforts, however, we are constantly being asked for more specific examples of what they can do to help adapt. The following looks at some common resource management planning processes and recommends new tactics and actions to be considered for incorporation to help adapt to the changes underway. Adapting to climate change in resource planning is very new and there are very few plans that have taken climate change into account to use as examples.

The Sierra Nevada Alliance considers these actions as works in progress. We encourage everyone to stay networked with the Alliance as you work on these efforts and provide us feedback on what is practical and effective in your planning and what is not. The Alliance will be sharing information about these efforts and updating this toolkit over time.

The following planning processes present opportunities to incorporate climate change planning principles and are reviewed in greater detail in this chapter.

A. Water & Watershed Management

1. Flood Management
2. Dam Relicensing
3. Watershed & Fisheries: Assessment, Protection, and Restoration
4. Water Supply

B. Species Protection

C. Forest Management

D. Wildfire Management Strategies

E. City & County Land Use Planning

1. Community-Wide Land Use Impacts
2. Site-Specific Land Use Impacts
3. Reducing Emissions Through Better Land Use
    i. Community-Scale Recommendations
    ii. Site-Specific Recommendations

A. Water & Watershed Management:

"Climate Change has the potential of affecting a wide variety of water resource elements. These range from water supply, hydroelectric power, sea level rise, more intense precipitation events and larger floods, water use, and a number of miscellaneous items which include water temperature changes."

Maury Roos, State Hydrologist,
California Department of Water Resources

Currently there are many different management strategies to address water supply for human and instream use, water quality, hydropower, flooding and safety, recreation, and ecosystem health. Over the last century, prior to the emergence of the environmental ethic and public trust, Sierra Nevada water planners primarily managed for human consumption, hydropower, and flood attenuation to the detriment of other resource values such as water quality, recreation, and ecosystem health. It is critical for water planners to address the range of water management components: water supply (human and instream), water quality, hydropower, flooding and safety, recreation, and ecosystem health. This toolkit addresses each one individually.

Vulnerability of Natural Water Systems

Experts project that temperatures will increase substantially under future climate change conditions and spring snowpack in the Sierra Nevada will decline between 25 to 40 percent.[45] This decline in snowpack will affect the timing and quantity of stream flow.

With higher air and water temperatures, and changes in stream flows, climate change will further threaten already degraded habitat and species. These climate changes cast even more uncertainty on the viability of some endangered and special-status species, such as salmon and steelhead trout unless we start adjusting our resource management to be adaptable now. Highly variable river stage changes can also scramble aquatic biota, fisheries and their habitat, putting additional stress on impacted native fisheries.

Rising temperatures and changes in precipitation will cause changes in the biomass, production and composition of terrestrial communities surrounding lakes, rivers, streams and wetlands. These changes may affect the supply of organic matter to freshwater systems, shading and light, as well as the characteristics of runoff entering the system.

Rising temperatures and evaporation may cause an increase in fires in some regions which could lead to harmful increases of nutrients in waterways from burned vegetation; increased sediment load in waterways caused by increased erosion on charred upland slopes; and without the protection of trees, increased wind exposure can increase evapotranspiration off water bodies. An increase in fire will also mean less organic matter (e.g. woody debris) will make it into the waterway, which would normally provide nutrients and habitat for aquatic life.

Increased air temperatures will also have a drying effect on many wetlands. For example, fairy shrimp, which live in ephemeral wetlands, are already losing habitat and could go extinct if warmer air temperatures reduce the wet season and evaporation eliminates their shallow vernal pool habitats. In addition, increased air temperature could cause intense flooding, which can scour streambeds, displacing organic matter, bottom-feeding organisms and small fish fry. Warmer air temperature will also warm waterways, resulting in decreased oxygen levels, which may have negative impacts on eggs and

larvae. Substantial increases in flood frequency could cause a shift in species composition, possibly eliminating many species.

In river systems, climate change is expected to facilitate the spread of non-native wildlife and plants. Once thermal barriers to invasion are removed, invasive species may outcompete native species. Climate change will change air currents, which will impact micro-climate weather conditions.

The cumulative effect will be that some rare and unique habitats needed for certain species' breeding and mating may change dramatically or disappear altogether.

Vulnerability of Built Water Systems

The United States has invested hundreds of billions of dollars in dams, reservoirs, diversion structures, and other hydrologic water management strategies to manage water resources. These systems were designed for and are primarily operated today on the assumption that future climatic and hydrologic conditions will have the same characteristics as past conditions.

Reliance on past water management strategies is a mistake. Climate changes will produce future hydrologic conditions that current man-made systems were not designed to manage. Scientists expect climate change to happen quickly and unpredictably, which could overwhelm man-made infrastructure like dams, reservoirs, and sewer systems.

In the face of such uncertainty, it will be tempting to turn to engineering and technology to solve these problems. However, it will be extremely expensive and complex to try to adjust our infrastructure that is built for historic climatic conditions. Instead, some of our best options for adapting to future climate change scenarios lie in restoring the function and resiliency of natural water systems, such as high Sierra mountain meadows, wetlands, floodplains, and watersheds with healthy forests. Equally as important, we should reduce our reliance on man-made water systems through far-reaching water and energy conservation measures.

At the heart of the water and climate change conundrum, we need to implement policies that slow human-induced climate change. California's water consumption drives much of its energy production and therefore, carbon emissions. Of the state's energy consumption, approximately 19 percent of electricity, 30 percent of natural gas, and 88 million gallons of diesel are used to convey, treat, distribute and use water and wastewater[46]. The California Energy Commission (CEC) estimates 44 million tons of CO2 emissions are expelled annually to provide the 44 million acre feet (MAF) of water used statewide. Therefore, when a unit of water is saved, so too is the energy required to convey, treat, affect local delivery, perform wastewater treatment, and safely dispose of that unit of water. In short, saving water saves energy. Saving water that gets treated as wastewater saves even more energy. Saving water that gets heated or additionally pressurized saves still more.

Everyone involved in water management at the local, regional, state and national level needs to put water conservation first when making decisions about our water. Increased investment in water efficiency represents a sound water management approach to future climate change impacts. Cost effective water conservation investments can generate significant benefits for water supplies and aquatic ecosystems, as well as reduce energy consumption and greenhouse gas emissions.

Water districts, local, state and federal agencies, non-profits and communities will play major roles in stewarding our scarce water resources in the face of climate change. Diverse stakeholders should join together in every forum to build the following seven adaptation principles into all planning efforts to protect the Sierra's unique watersheds and supply high quality water to Sierrans, Californians and Nevadans.

1. Flood Management Opportunities to Adapt

Identify future change through modeling

- **Re-examine current operations using information from future scenarios:** Water managers should begin a systematic reexamination of engineering designs, operating rules, contingency plans, and water allocation policies under a wider range of climate conditions and extremes than have been used traditionally. For example, the standard engineering practice of designing for the worst case in the historical observational record may no longer be adequate.
- **Remap the floodplain** to identify flood potential well beyond the 100-year flood forecast. FEMA and the state should map the biggest, reasonably foreseeable storm events possible in order to provide a more realistic land use planning gauge.

Use adaptive management strategies to maintain flexibility

- **Incorporate weather forecasting into all dam operations:** Dam "rule books" need to incorporate flood forecasting into decision making so that dam operators can make "pre-flood" water releases in order to have plenty of space available for anticipated flood flows.

Prioritize projects that will succeed under multiple scenarios

- **Set back levees to enlarge floodplain storage areas:** Spreading out flood flows across a wider area is one of our best tools to reduce the risk of catastrophic flooding for humans and our environment. Wider floodplains allow water to slow, sink, and soak into the ground, resulting in the valuable benefit of recharging aquifers. Reconnecting floodplains to their associated rivers can provide biological hotspots where salmon and other native aquatic life thrive and do better than if they are constrained to the mainstem river. Levee setbacks can also reduce or reverse damaging channel and bank problems, helping protect existing spawning gravels and riparian resources and increase groundwater infiltration.
- **Evaluate needed changes** to transition from dual-use hydropower and flood protection dams to single-use hydropower dams or single-use flood protection dams. Currently, many of California's dams are used for both hydropower and flood protection. This is possible because the operations for each use happen at different times of the year based on historic precipitation patterns. However, with climate change, these two management periods may increasingly overlap, forcing water managers to choose to manage for flood protection or hydropower rather than both. Water and utility managers should consider other flood protection methods such as levee setbacks and connecting rivers to their floodplains to address attenuate flooding. This would reduce pressure to use these dams for flood protection only and allow more flexibility to manage them for water supply and hydropower generation.

- **Evaluate the relative costs and benefits as well as regional applicability of non-structural flood management options**, such as water conservation and efficiency measures; levee setbacks, meadow restoration, floodplain inundation; groundwater recharge, stormwater management, improved management of floodways below big dams, and prohibition of new development in floodplains. Protecting floodplains, restoring wetlands, and adopting natural stormwater management techniques will be important steps toward safeguarding communities and our environment.
- **Land use planning that assumes more frequent flooding and protection of floodplains to slow and attenuate floods rather than dams and levees, which increase risk of catastrophic flooding downstream and systems failure.** Land use planning should reduce new development and redevelopment in flood-prone, low-lying areas subject to more frequent flooding.
- **Participate in Integrated Regional Water Management Planning (IRWMP):** Ensure those involved in water management and resource protection in your area participate in IRWMP for your region. If there is not a current effort, start one. IRWMP is an opportunity to form a coordinated approach to meet your water objectives, water supply, water quality and ecosystem health objectives at the same time. It is also an opportunity to coordinate and prioritize water management projects for your region to meet its objectives for water supply (human consumption and instream), water quality, ecosystem health, recreation, hydropower, and flood management. In an IRWMP you can develop a group of water resources stakeholders who benefit from a collaborative forum for problem-solving, sharing resources and attracting funding.

2. Dam Relicensing Opportunities to Adapt

"If we want to effectively protect against environmental degradation caused by global climate change, locking in new 30-year FERC licenses based on the status quo does us no good. Relicensing stakeholders must look ahead and anticipate operational and environmental challenges in order to structure creative and flexible solutions to future climate scenarios."

Laura Norlander, Director,
California Hydropower Reform Coalition

Identify possible future changes through modeling

- **Build in studies to relicensing processes:** In most Sierra rivers, studies will be needed to examine new management strategies protecting or maintaining coldwater fisheries that depend upon cold water inflow, a cold water pool and cold water releases from dams. Studies should be done to examine how existing mitigation strategies like fish ladders, screens or hatcheries will be affected by climate change.

Use adaptive management strategies to maintain flexibility

- **Set specific standards in new licenses:** Make sure license conditions contain specific standards the licensee must meet independent of external pressures. Be specific about exact temperatures should be for particular fisheries and stretches of river. License conditions should not describe limited operational changes, such as "the licensee will increase instream flows by 20 cfs from historic operations in order to keep the stream at 16 degrees C." Under climate change

scenarios, dam operators might have to increase the instream flow even further in order to keep the stream at 16 degrees C.

- **Build opportunities for "re-openers" in the license conditions** to consider alterations like climate change. Triggers should be built into all new licenses, such as, "if air temperature at Garden Bar increases an average of 2 degrees Fahrenheit, the license will be reopened to discuss measures that will address climate change."
- **Participate in Integrated Regional Water Management Planning (IRWMP):** An IRWMP can provide another collaborative forum for the players in a hydropower relicensing. This alternative forum provides a space to develop and implement agreements and projects that may not come under the purview of relicensing. IRWMPs may also provide relevant information or solutions to a relicensing proceeding.

3. Watershed & Fisheries Management Opportunities to Adapt

"Climate, in large part, drives the character of our watersheds and landscapes, and it is changing, perhaps faster than we care to believe. To keep from being overwhelmed by this change we should look to manage our watersheds to accommodate change."

-Stefan Lorenzato, Statewide Watershed Coordinator, California Department of Water Resources

Identify possible future changes through modeling

- **Model your watershed.** Hydrologic and planning models can help inform numerous important questions about our watersheds. Future rising temperatures, the resulting variability in flows and related sediment dynamics, the effect of temperature change on fish life cycles needs, invasive species, predators and disease will all be important to enable protection of the Sierra's rivers.

Use adaptive management strategies to maintain flexibility

- **Preserve habitat connectivity** to allow species access to migration routes and thermally cooler temperatures. Connectivity is important not only between different freshwater habitats (i.e. rivers, lakes and wetlands) but also along the length of rivers and between fresh surface water and groundwater. Cooling headwaters and tributaries should be protected to provide cooling temperatures to the mainstem rivers. Protecting tree canopy and vegetative cover that shades the margins of water bodies can also help keep temperatures down. Planners should consider protecting areas where species are likely to migrate to find their optimal temperatures and habitat despite the fact that under current conditions, these areas may not be high priority wildlife protection.

Promote the resiliency of existing ecosystems and minimize stressors

- **Protect physical features rather than individual species.** Protecting flow patterns, water quality and water quantity will go a long way towards protecting biodiversity in freshwater habitats. Conservation efforts that focus solely on preserving particular species or groups of species without considering wider physical features of the system may fail. But don't let this stop you from forming campaigns around publicly-known species that attract funding and attention!

- **Manage entire watersheds not just pieces.** Managing entire watersheds rather than simply protecting aquatic elements or habitat patches will become increasingly important as the effects of climate change intensify and are magnified by interactions with human stresses. For instance, timber harvesting close to rivers decreases the forest canopy's cooling effects on adjacent waterways, decreases riparian vegetative cover, increases the input of sediment and reduces the input of the large, woody debris which is crucial for healthy aquatic habitat.

Prioritize projects that will succeed under multiple scenarios

- **Reduce human water demand and change water use behavior:** Climate change adaptation strategies should include incentives for conserving water, water efficiency standards for irrigation, industry, commercial, and residential.

Integrate and coordinate local efforts

- **Join Integrated Regional Water Management Planning (IRWMP) processes** to work with others to protect entire freshwater ecoregions and provide a basis for long-term conservation. In an IRWMP, all the stakeholders in a watershed (e.g. local community members, county representatives, water and fishery resource managers, conservationists, water agencies, tribes and businesses) jointly assess their objectives, prioritize projects and can develop adaptive management strategies. If all the stakeholders in the region manage a watershed, there will be a better chance of protecting areas that are particularly vulnerable to climate change. It will also minimize land use practices and other human stresses that can exacerbate the negative impacts of climate change. These collaborative groups can also work to find opportunities for water management brought by climate change.

4. Water Supply Opportunities to Adapt

Identify possible future changes through modeling

- **Conduct groundwater studies:** Little information is available on how climate changes might affect groundwater aquifers, including quality, recharge rates and flow dynamics. In fact, the Sierra's water stakeholders and managers still need to understand the basic function and recharge of our fractured rock aquifers as well as understand the connection between surface water and groundwater. Climate change further highlights the great need for this basic planning information, which should inform land use decisions to protect groundwater recharge areas, manage well and groundwater pumping so they don't cumulatively dewater the baseflow of rivers or overdraft groundwater supplies.

Use adaptive management strategies to maintain flexibility

- **Invest in new technologies to develop new water supply and improve reliability for human consumption and our environment:** Traditional and alternative forms of technology can play a role in addressing changes in both supply and demand of water caused by climate change and the resulting variability in water availability. Options to be considered include water recycling, graywater, rainwater harvesting, stormwater capture, wastewater reclamation and reuse, water marketing and transfers, and even limited groundwater desalination. It is yet to be seen what types of innovative water reuse is best suited to the Sierra's rural communities or its more populated growing towns.

- **Encourage greater water efficiencies** by retrofitting infrastructure. In the Sierra, one of the biggest opportunities for improving efficiency is in lining and encasing sections of historic open dirt ditches while providing deliberate water allocation to critical habitat fed by these historic ditches. Efficiency measures for irrigation and landscaping may provide the most far-reaching technologies for the Sierra's rural agricultural lands. For example, weather stations measure microclimates and feed information back to smart controller irrigation timers. On a smaller scale, soil moisture sensors can help reduce landscape and irrigation for watering in both urban and agricultural areas.
- **Save a percentage of conserved water for instream flows:** Using the model for water trusts developed in Washington and Oregon, the Sierra can work with water efficiency programs to ensure that a percentage of water saved gets dedicated in the short-term or in perpetuity to instream flows and not just for increased development opportunities.
- **Reduce peak power** use by encouraging greater energy efficiencies. This will reduce the demand for hydropower, which often competes with environmental and recreational needs for water supply.

Monitor and track changes in weather, hydrology and ecosystems

- **Consider climate change when making commitments about future water deliveries:** Water agencies and irrigation districts should avoid promising increased water deliveries based solely on current hydrology, without taking future climate conditions into account. Hydropower utilities should also plan ahead to meet their minimum requirements for FERC, state, and federal agencies under future climate change scenarios in which the water regime will change.
- **Prioritize projects that will succeed under multiple scenarios.**
- **Promote tertiary water treatment with wetlands,** which can conserve open space, treat water onsite and locally, recharge local groundwater, reduce energy use, and restore native habitats.
- **Bank water in naturally occurring "infrastructure"** as provided by wider levee setbacks and restored meadows and wetlands. In wet years, water can be saved through groundwater banking and recharge methods in the Central Valley.
- **Increase the efficiency** of all water and wastewater treatment operations to cope with climate change impacts such as increased flows.

Integrate and coordinate local efforts

- **Change County Building Codes and General Plans:** Counties can have an effect on water supply and conservation through changes in Building Codes and General Plans (see more in Development and Planning sections). Promotion of features such as green roofs and porous surfaces can reduce storm water runoff and reduce non-point source pollution runoff to waterways. Building codes can be changed to allow the adoption of gray water use. Household rainwater catchment systems can be encouraged.
- **Promote conservation pricing and water recycling:** Water agencies and irrigation districts should join the California Urban Water Conservation Council and implement their best management practices including their Conservation Pricing policies.

- **Review the legal allocation of water rights** to address inequities, environmental justice concerns, and inefficient use of water. The risks of climate change make such a review even more urgent.

B. Species Protection

The Sierra Nevada is a topographically and floristically diverse region of the western United States. While it comprises only a fifth of the total land area of California, half of the native plant species in the state occur within the range. In addition, more than 400 plant species are endemic to the Sierra Nevada and many of these are listed as threatened or have other special conservation status.[47] The Sierra's flora and fauna have been altered by factors such as roads, fire, invasive species, and development, and many new developments are being planned. Climate change is exacerbating these changes and bringing new challenges. For instance, scientists from the Grinnell Project have tracked several mammals' migration to higher elevations in the Sierra Nevada since the 1900's.[48]

Land managers, planners, policymakers, private landowners and conservation groups still have time to devise and implement adaptations to protect and conserve the Sierra's ecosystem from new threats posed by climate change. We need to prepare for the consequences of climate change through careful planning and investments in the following actions and adaptation strategies.

Identify possible future changes through modeling

- **Identify what needs to be protected:** It is vital to quickly identify which species, species assemblages, habitats or landscapes will be particularly sensitive to climate change and also to recognize which will be most resilient. Particular attention needs to be paid to keystone species such as pollinators or seeders. Wilderness and roadless areas should remain undeveloped as these native-dominated communities can serve as models to help us understand how unaltered areas respond to climate change.
- **Predict where critical habitat will be in the future** and work now to protect it. Use predictive models to identify refuges and places where species will migrate. Then create conservation systems that allow species to move. Most current conservation efforts focus on preserving particular species and ecosystems, which are fixed in one geographic area. However, when a species starts to move due to climate change, we need to be protecting not only where it is today, but where it will be in the future, and connections that allow it to get it from point A to point B. The use of conservation easements may be a useful tool to use to allow for these new migration corridors.

Use adaptive management strategies to maintain flexibility

- Maintain or mimic natural fire regimes (See Forestry).

Promote resiliency of existing ecosystems & minimize stressors

- **Prevent and minimize road impacts on native habitats:** Protection of roadless areas and relatively intact habitats should be a priority, as habitats distant from roads and human disturbance often serve as refuges for native species. Fragmentation of ecosystems by roads contributes to reduction in biodiversity and the spread of invasive species. Avoid road construction in roadless or vulnerable habitats and avoid creating corridors for ORV use in these areas. Road maintenance should: be timed to avoid the spread of invasive species,

and reduce stream sedimentation; use native species in soil stabilization and revegetation operations; ensure that roadfill used in road maintenance operations is not contaminated with weed seeds.

- **Prevent and control the spread of invasive weeds and other species:** Aggressive, prevention-oriented and adaptive approaches should be used to control the spread of invasive species before lands become invaded. More knowledge is needed regarding vectors of introduction and dispersal, including the roles (and effects) of logging, roads, trails, human visitation, cars, heavy equipment, pack animals, and livestock. This knowledge would aid in understanding where to look for incipient outbreaks and identifying vegetation communities that will be most vulnerable to full-scale invasion. This will require persistent monitoring, rapid eradication of incipient infestations and coordination with neighboring landowners to prevent adjacent lands from providing seed sources for re-colonization. Land managers need to perform systematic surveys of distribution and abundance of the main problem invaders, with coordination for monitoring and control efforts at a regional scale.

C. Forest Management

"If we take proactive measures now to actively manage forest density, substitute thriving tree species for failing species, and salvage trees during dieback, we may be able to minimize the negative ecological and economic impacts of climate change over the next century on U.S. forests."

-Carole Kennedy, Watershed Program Manager, Forest Soil Scientist, Tahoe National Forest

As mixed evergreen forests extend their range upward, losses of alpine and sub-alpine vegetation cover could reach 40-50% before 2050 and 60-80% by 2100.

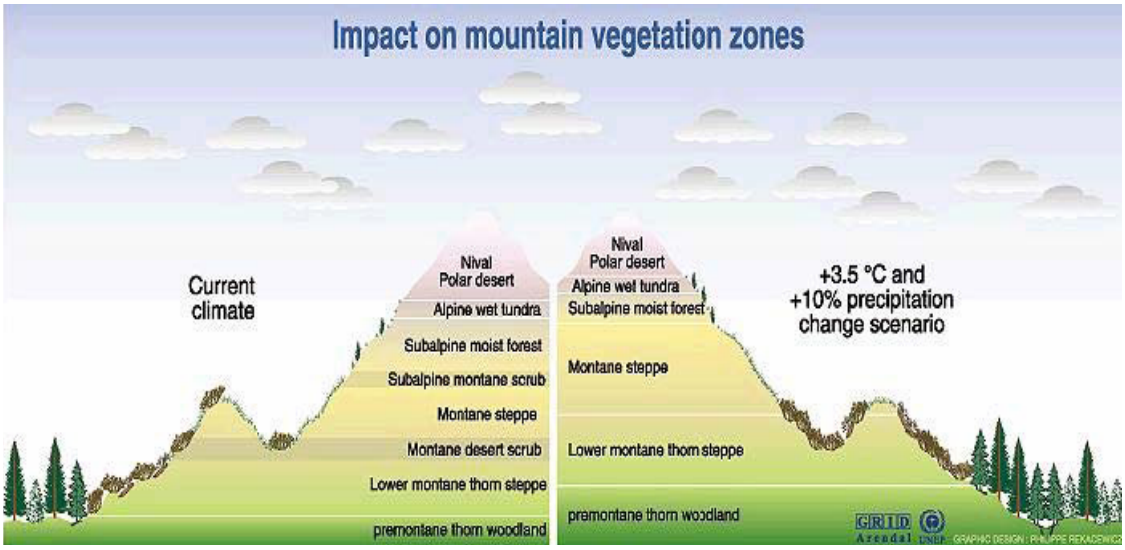


Figure10
"Impact on mountain vegetation zones." Intergovernmental Panel on Climate Change (IPCC) -- See Endnote 1.

Global warming is expected to have widespread effects on the productivity and health of California's forests. Forestlands cover 45 percent of the state, most of it in the Sierra, and commercial forests such as pine plantations cover 16 percent of the state.[49] If average statewide temperatures rise between 5.5 and 8°F, the productivity of mixed conifer forests is expected to shrink 18 percent by the end of the century.[50] The reductions in yield from pine plantations are expected to be even more severe, declining 31 percent by the end of the century.[51] Throughout much of the northern part of the Sierra Nevada, forest composition will change from evergreen conifer forests (dominated by Douglas fir and

white fir) to mixed evergreen forests (dominated by tan oak, madrone and live oak.)[52]

Many of the Sierra's forests have undergone serious fragmentation and degradation from roads, forestry practices and development and forests migrate very slowly as their local climate changes. It is in combination with these threats that the impacts of unprecedented rates of climate change can compromise forest resilience and distribution. Many pests which are normally limited by cold temperatures will expand their range and forests will be ill-equipped to deal with their infiltration if ecosystem health is already compromised. At the same time, some pests will be given longer times to flourish under warmer winters. A longer fire season and drier conditions are projected to increase wildfire severity as a result of climate change.

The California Department of Forestry, the Board of Forestry, the U.S. Forest Service, other Federal land managers and private forest owners need to work to maintain healthy Sierra forests in the face of climate change. Numerous federal and state policies affect the conservation and use of these forests including the state Forest Practices Act and the Sierra Nevada Forest Plan Amendment 2001. These policies, and proposed changes to them, must include the following actions:

Use adaptive management strategies to maintain flexibility

- **Manage carefully for biomass benefits:** Using forest products as a source of biomass energy can present a conflict between climate mitigation and other environmental objectives. This is because a trade-off exists between leaving carbon in standing forests and producing a sustainable flow of renewable woody biomass that can be used to produce energy (instead of fossil fuels) or building materials (instead of energy-intensive steel or aluminum). While increased forest carbon storage yields climate benefits, greater mitigation may be possible over time by managing forests for the long-term production and use of biofuels. Managing for biomass should only be an option if deleterious effects on biodiversity can be avoided (i.e., if the action is fully compatible with the Forest Stewardship Council's guidelines for biomass management).
- **Maintain historic fire regimes and monitor changes:** Most forests and their biological features evolved in balance with a natural fire regime. These natural patterns are thus a critical ecosystem process. Fire is often a primary determinant of a forest's species composition. In fire-prone regions, for example, fire-tolerant species dominate. For these species, infrequent hot fires are important for seed germination and suppression of faster-growing but fire-susceptible species. By suppressing natural fires, fire-tolerant species become competitively disadvantaged.

  Historic fire regimes will undoubtedly shift as a result of climate change. For example, the average fire return interval in a given area may increase or decrease as a result of change in vegetation, moisture and other factors. Because of regional differences in fire ecology, and the lack of data on how fire ecology will change, fire policies established in response to climate change should not be uniform; rather they should be established based on what is known of the fire ecology of a particular region and forest type, and they should be adapted to respond to changing conditions. A mixed strategy in which managers let some natural fires burn, protect old-growth and communities from stand-replacing fires, and manage stands through prescribed burning and understory thinning, is the optimal approach.

Monitor & track changes in weather, hydrology & ecosystems

- **Actively manage pests:** In ecosystems where pests are predicted to have a significant impact in the system outside the normal range, an active management program to reduce the negative effects of the pests should be devised. USDA Integrated Pest Management Programs need to be building climate change modeling and monitoring into all their projects.

Promote resiliency of existing ecosystems and minimize stressors

- **Maintain diversity:** Because climate change will have differential impacts upon different species and age classes of trees, it is essential to maintain a diversity of age stands and mix of species. This will contribute to maintaining productivity of the forest system as climate changes.
- **Reforestation:** Recent studies have estimated that approximately 9 million acres of land in California could be reforested to increase carbon stocks and provide other benefits. Each of these acres has the potential to store between 150 to 230 tons of carbon. Projects should focus on restoring native tree cover on lands that were previously forested and are now covered with other vegetative types.[553]
- **Avoid fragmentation and maintain connectivity:** Roads exacerbate the effect of a warmer climate by increasing the incidence and rate of pest and disease invasions by encouraging the dispersal of invasive species. The proliferation of roads also encourages more human uses resulting in the potential for increased wildfires. Much public debate surrounds the Roadless Area Conservation Rule, finalized by the U.S. Forest Service in January 2001. This rule calls for ending nearly all logging, road building, and new coal, gas, oil and other mineral leasing in 58.5 million acres of the wildest remaining national forest lands, with 11.5 million acres in the Sierra. Federal government efforts to weaken the Rule would threaten land that serves as habitat for threatened and endangered species, provides quality recreational opportunities, protects against invasion of non-native species, protects watersheds, and stores significant quantities of carbon.
- **Protect functional groups and keystone species:** Maintaining the natural diversity of species and functional groups in forests is a sound overall strategy for enhancing both resistance and resilience to climate change. Reduction of single species plantations is important because studies demonstrate increased tolerance to environmental extremes and recovery potential as species richness increases. Mature forests have well-established root systems, and are therefore better able to withstand drought-like conditions, whereas younger forests and post-disturbance stands are more vulnerable to decreases in moisture.
- **Reduce Present Threats:** The most obvious strategy for improving forest resilience to climate change is to promote overall ecosystem health. Identifying and targeting for action the reduction of fragmentation and degradation will go far in ensuring that forest structure, composition and function increase a forest's resilience. Guidelines laid out in the 2001 Forest Framework regarding the thinning of small diameter trees and the responsible use of fire need to be re-established as tools to restore forest health across the 11.5 million acres of federal land in the Sierra. Appropriate levels of federal funding need to be restored to support the removal of small diameter trees, ladder fuels and surface fuels.

- **Protect Mature Forests:** There is a widespread and misguided belief that logging or clearing mature forests and replacing them with fast-growing younger trees will benefit the climate by sequestering atmospheric CO2. While younger trees grow and sequester carbon quickly, the fate of stored carbon when mature forests are logged must also be considered. When a forest is logged, some of its carbon may be stored for years or decades in wood products. But large quantities of CO2 are also released to the atmosphere---immediately through the disturbance of forest soils, and over time through the decomposition of leaves, branches, and other detritus of timber production. One study found that even when storage of carbon in timber products is considered, the conversion of 5 million hectares of mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon in the atmosphere. Mature forests and other forest areas with recognized high conservation value should be fully protected. Even careful commercial forestry operations in high conservation value forests impose substantial costs to other forest ecosystem services such as biodiversity conservation, watershed maintenance, recreation and other forest amenities.

Prioritize projects that will succeed under multiple scenarios

- **Prevent conversion to plantations and practice low intensity forestry:** Forestry operations that minimize soil disturbance and avoid clearcutting and chemicals help reduce the invasion of exotic species and the loss of carbon from the soil. Old forests are more efficient carbon storage sinks than planted tree farms because of the high duff layers, organisms in the soil, and the large trees, downed logs, and canopy. After clearcutting, massive amounts of carbon are released into the atmosphere. It will take hundreds of years before the little trees that are replanted after clearcutting replicate the carbon storage capacity of a mature forest. Studies have already demonstrated that the conversion of 5 million hectares of mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon in the atmosphere.[54]

D. Wildfire Management Strategies

The frequency and severity of wildfires in the West is growing. A recent study of fire in the Western US found that there were four times more wildfires in the last fifteen years than during the previous fifteen years. The total area burned by those fires also increased dramatically, by 650%. Much of this increased fire activity was concentrated in mid-elevation forests at about 5512-8825 ft. in Northern California and the Northern Rockies.[55] The same study also found that the recent increase in wildfire activity is correlated to an increase in average spring and summer temperature. This indicates that global climate change has already begun to affect wildland fire in the western US.

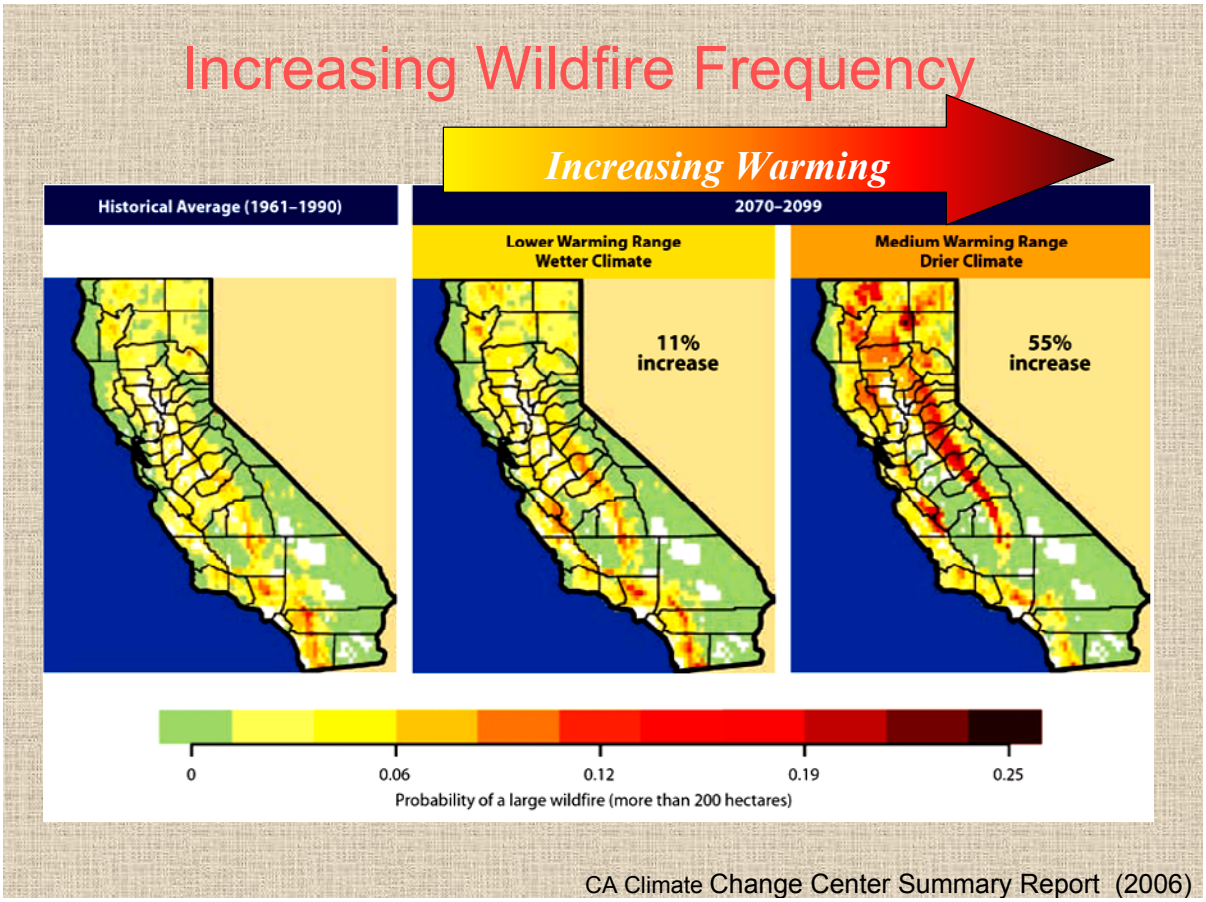


Figure 11
California Climate Change Center. "Our Changing Climate: Assessing the Risks to California." 2006.

If average statewide temperatures rise to the medium warming range, the risk of large wildfires in California is expected to increase about 20 percent by mid-century and 50 percent by the end of the century.[56] These changes will dramatically alter the historic fire regimes in Sierra forests, which have already been impacted by 150 years of logging and fire suppression. The compounding influences of fire suppressions and climate change make it increasingly important for communities and individual homeowners to take action to proactively manage wildfire.

Homeowners and developers should take care to use ignition-resistant building materials and create defensible space around existing and new homes. Communities, neighborhood associations and land management agencies should partner with Fire Safe Councils to design community wildfire protection plans and fuel treatment programs to reduce fire hazard in wildland areas adjacent to communities. These plans should include ongoing monitoring and adaptive management strategies to respond to changing fire regimes.

Lastly, communities should use the tools of urban planning to limit development in wildfire-prone areas. See section E: "City & County Land Use Planning" for more information.

Identify possible future changes through modeling

- **Model wildfire behavior:** Powerful new tools such as fire behavior modeling allow fire managers to map probable wildfire behavior in a given area. These tools can be used to model a variety of different future scenarios. The results can then be used to develop community wildfire protection plans, design and prioritize fuel treatments, and identify areas which are inappropriate for development.

Monitor & track changes in weather, hydrology and ecosystems

- **Monitor changes in fire behavior and fuels:** Fire managers should monitor changes in wildfire frequency and severity, fire return interval, changes in fuel type and load, and average temperature and humidity, and feed this information into planning and response efforts.

Use adaptive management strategies to maintain flexibility

- **Create adaptive wildfire management plans:** Community wildfire protection plans (CWPPs), fuel treatment programs, and other wildfire management plans should be designed to respond to changing fire behavior and fuels.
- **Manage the forested landscape to restore resiliency:** Sierra forests are already stressed due to 150 years of fire suppression and logging. Climate change will add additional stress and exacerbate wildfire hazard. State, federal and local agencies should promote responsible forest management and invest in fuel reduction programs (such as controlled burning and hand-thinning of small trees and brush) that restore forest health and reduce the risk of catastrophic crown fire.

Prioritize projects that will succeed under multiple scenarios

- **Create defensible space:** Homeowners should create defensible space around homes and buildings, and local governments should help ensure compliance by creating mandatory defensible space requirements and doing outreach, education and enforcement.
- **Use ignition-resistant building materials:** New development in wildfire hazard areas should be required to use ignition-resistant building materials and existing homes should be retrofitted to the extent possible.

Integrate and coordinate efforts

- **Strengthen CEQA requirements for fire hazard:** The California Environmental Quality Act (CEQA) encourages agencies to consider wildfire hazard as a potential impact that should be examined and mitigated. However, this provision is rarely utilized and many projects that would increase the risk of catastrophic wildfire are approved without mitigation. The State of California should revise CEQA to clarify how impacts should be analyzed and suggest mitigation measures.
- **State and Federal agencies can support local actions:** CalFire and the USFS already play an important role in local planning in some parts of the Sierra. CalFire and USFS staff often review draft plans, codes and development applications and make recommendations. CalFire and USFS could expand their role in local policy development by providing technical assistance, planning grants, stakeholder convening and policy development in partnership with local governments.
- **Improve planning and budgeting processes to fully address risk:** All levels of government involved in wildland fire prevention need to improve planning and budgeting to adequately plan and prepare for coordinated wildfire prevention and response efforts in response to increasing wildfire hazard. If we are to take action, we must first understand the full scope of the problem.
- **Assess true costs of fire protection – and budget accordingly:** Most Sierra counties lack the funding to adequately fund fire prevention. Funding mechanisms such as developer impact fees and assessment districts are non-existent or woefully inadequate. Local governments should examine the true, long-term costs of fire prevention and protection and create or expand these mechanisms to attain budgetary needs.

E. City & County Land Use Planning

"We're already seeing the impacts of climate change on the ecosystems of the Sierra. We need to address these changes in all our current and future land use planning decisions to make sure that we protect our economic and ecological future for generations to come."

-Terry Watt, Planning Consultant

When deciding where and how the Sierra will accommodate population growth, climate change is an important consideration, both in terms of reducing emissions to prevent catastrophic change, and adapting to the changes already underway. Sprawling land use patterns increase greenhouse gas emissions by encouraging longer commutes and discouraging walking, bicycling and alternative transportation. On the flip side, the impacts of climate change-such as extreme weather, wildfire danger and flooding—will increasingly affect the integrity of the built environment unless action is taken now.

1. Community-Wide Land Use Impacts:

Climate change has already begun to affect the safety and sustainability of Sierra communities, and future impacts could be severe if action isn't taken to minimize hazards through improved land use planning.

Wildfire is at the top of the list of climate-induced community hazards. As Sierra summers become hotter and drier, the risk of homes and lives being lost to catastrophic wildfire is increasing. The 2007 Angora Fire near South Lake Tahoe is a good example of how reduced snowpack and high summer temperatures can combine to create an extremely dangerous fire season. These risks can be reduced through better land use planning that limits the incursion of development into fire-prone wildland areas.

In every community, there are areas which are more dangerous to develop, and areas which are safer. Topography, vegetation, slope, proximity to existing emergency services, roads and municipal water supply are just some of the features which can help determine which areas are safe for development, and which are more dangerous. By looking at fire danger at the scale of the entire community, rather than the individual property, city planners and fire managers can direct growth into safer areas, and limit development in areas of extreme hazard and that are likely to be more hazardous in the face of increased climate change.

As climate change impacts the Sierra's hydrology, leading to more rain and less snow, flooding may also become an issue. Many Sierra communities are built in river canyons or floodplains where extreme floods may jeopardize homes and other buildings. Land use planners need to take these potential impacts into account when setting new development near Sierra rivers and creeks.

Hydrological changes may also affect water supplies. Most new development in the Sierra relies upon private or semi-private wells, yet the aquifers which supply this groundwater are poorly understood. Just as climate change will affect the surface water in our rivers and creeks, it will likely affect our groundwater aquifers as well. Sierra planners and water providers should work together to better understand our Sierra aquifers, and ensure that new development has a stable and predictable source of water over the long term.

2. Site-Specific Land Use Impacts:

New buildings need to be able to withstand the impacts of climate change over the next 50 to 80 years to guarantee their long-term sustainability. Buildings and their locations could all be adversely affected by extreme weather events, fluctuations in temperature and precipitation, adversely affecting their structural integrity, external fabric, internal environment and service infrastructure.

Developers and those who invest in new development should consider the financial implications of climate change as a key component of the business case for building, and investing in a development. As climate change impacts become more widely understood, well-designed buildings, properly protected from climate change risks will be easier to sell or rent, and at a higher price.

The location and design of new buildings should minimize vulnerability to climate change. Acting early may mean that resilience to climate change can be incorporated into the planning and construction process at a relatively low cost. In the longer term, building climate resilience into new buildings and development will avoid unnecessary climate-related damages and costs, as the impacts of climate change begin to be felt more intensely. It will also avoid the need for expensive retrofits.

3. Reducing Emissions Through Better Land Use:

As mentioned previously, it is important for new development to not only adapt to climate change, but also mitigate the greenhouse gas emissions associated with new development. New development produces greenhouse gas emissions in two ways: through energy used in the building itself (for heating, cooling, landscaping, etc.), and by dictating how we get from place to place.

Buildings have a significant impact on energy use. They account for approximately 40% of total energy use, 71% of electricity use, and 33% of all CO2 emissions in the United States. Buildings also account for 40% of all materials and wood use, and 25% of all water use in the United States.[57] About 75% of energy used in buildings is wasted due to poor design, construction, and inefficient appliances.

Sprawling, low-density development encourages long hours in the car, while compact, mixed-use development encourages walking, bicycling, using transit or driving shorter distances. 44% of California's greenhouse gas emissions come from transportation, and these are directly linked to sprawling land use patterns that encourage driving. In the Sierra, average vehicle miles traveled (VMT) per person increased by 30% between 1990 and 2000, while population grew by just 16%. This indicates that Sierra land use patterns are encouraging people to drive longer distances, which in turn increases the amount of greenhouse gases emitted into the atmosphere.

In 2006, California passed AB 32, the California Global Warming Solutions Act of 2006. This unprecedented legislation calls for a dramatic reduction of California's greenhouse gas emissions by 2020. The legislation envisions that a substantial portion of these reductions will come through changes in land use. Currently, the California Air Resources Board and other agencies are formulating new land use guidelines to achieve the mandate of AB 32. Sierra cities and counties can take proactive measures to reduce greenhouse gas emissions by encouraging more compact, 'smart growth' land use patterns that encourage walking, biking, transit and shorter commutes.

County planning departments, developers, contractors, architects and individuals need to build the following recommended actions into all new projects:

i. Community-Scale Recommendations:

Prioritize projects that will succeed under multiple scenarios

- **Promote infill and transit-oriented development.** Putting new development within existing communities, rather than allowing outward sprawl, will minimize greenhouse gas emissions and help keep new development safer from wildfire and flood hazards. Local governments should identify infill sites and encourage development of these areas to accommodate population growth. Tools such as redevelopment, transfer of development rights programs and fiscal incentives can be used to encourage infill development.
- **Concentric outward growth.** Where there is no room for infill development, local governments should encourage concentric outward growth that is compact and orderly. As with infill development, such growth patterns will minimize greenhouse gas emissions and discourage development in unsafe areas. Tools such as general plans, urban growth boundaries and urban reserve systems can be used to foster concentric growth patterns.

- **Cluster development.** New subdivisions should be designed to optimize walkability, safety and access by clustering new lots in low-hazard areas close to existing roads and neighborhoods. Clusters of development should be surrounded by a shared zone of defensible space. Local governments can require clustering as part of the General Plan, zoning code and/or subdivision regulations. Analytical tools such as fire behavior mapping can be used to assist planners and landowners in ascertaining the safest locations for new development.
- **Don't build in unsafe places.** Within a given area, some places are more prone to fire danger than others. Brushy areas, steep slopes, ridgelines and south-facing hillsides, for example, are often more fire-prone than other areas within the surrounding landscape. Other areas may pose a particular threat to an established community, such as a brushy canyon that sits adjacent to a town. New development should be curtailed in places that put new or existing residents at increased risk of catastrophic wildfire.
- **In unsafe places, build in safe patterns.** Local governments should strongly discourage new development in areas far from existing towns and communities. However, in situations where development is unavoidable due to existing entitlements, new homes and structures should be situated to minimize exposure to wildfire and flood hazards.
- **Adopt climate-friendly zoning and building codes.** Counties in the Sierra need to re-examine zoning codes and building requirements to take climate change impacts into account. Counties should adopt the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) and Neighborhood Design (LEED-ND) rating systems to assist planners, developers and the public with designing and building green buildings and communities.

Use adaptive management strategies to maintain flexibility

- **Examine climate change impacts and adaptation strategies as part of CEQA review.** When undertaking CEQA review for land use plans and specific development proposals, counties and cities should estimate the greenhouse gas emissions associated with the project and identify mitigation measures to reduce them such as compact, transit-oriented design, energy-efficient buildings, and mixing jobs, housing, retail and schools within walking distance of one another. CEQA documents should also address adaptation to changing climate conditions, and include ongoing monitoring to ensure that projects are adequately adapting to changing climate conditions.

Monitor & track changes in weather, hydrology & ecosystems

- **Build water sustainable communities.** Before approving new development, counties should ensure that there will be an adequate water supply for the slated development and for all future development allowed in their General Plan. Knowing the limits of the aquifer or other water supply, ensuring the efficiency of water delivery methods and infrastructure and using grey water are all essential components of smart development in a world impacted by climate change.

Integrate & coordinate efforts

- **Integrate land use and transportation planning.** Land use planning should be coordinated with transportation planning to ensure that new development maximizes walking, bicycling and transit use. MPOs and COGs should invest in alternative transportation and coordinate with local governments to achieve land use plans that take full advantage of these investments.
- **Use financial incentives to encourage conservation and smart growth.** Local, state and federal governments should develop grants, incentives and tools such as conservation easements and transfer of development rights (TDR) programs to encourage compact development and preserve important natural resources in the face of climate change.
- **Plan at the landscape level.** Counties, states, conservation organizations, land trusts and property owners should work cooperatively to develop large-scale land use plans that aim to achieve the complementary goals of determining which habitats should receive some form of protection, and which lands are less biologically important and thus more suitable for development.
- **Support better land use planning.** State and federal government agencies can provide grants to local governments to assist with conservation easements and fee-title acquisition of lands which should remain undeveloped. In addition, agencies can provide planning grants, decision-support tools and technical assistance to help communities do better planning.
- **Bring fire and emergency agencies to the table.** Local governments should ensure that fire safe councils, local fire departments, CalFire, USFS, and other emergency response agencies have a meaningful role in land use planning efforts and decisions.

ii. Site-Specific Recommendations:

Prioritize projects that will succeed under multiple scenarios

- **Ensure that building structures withstand future climate change.** Incorporate appropriate ventilation and cooling techniques. Drainage systems and entrance thresholds need to be able to cope with more intense rainfall. The exterior of buildings should reduce heat gain in summer, for instance with light colored paints. Construction materials need to be able to perform adequately in the climate throughout the lifetime of the development. Cooling and ventilation systems, where necessary, should be designed to use as little carbon-based energy as possible by using renewable energies and being as energy-efficient as possible. Renewable sources of energy should be used where possible, especially solar energy which is most available when cooling systems are most needed.
- **Use Water Wisely.** Consider using permeable paving for all pavements, driveways, footpaths, car parking areas and access roads. In developing the drainage plan for a new development site, ensure that the design takes account of climate change and that roads, paths, and other features of the site are designed to convey increased flows safely. Estimate the net water consumption of the development under current use, future use and under drought conditions for the lifetime of the project. Minimize water use in buildings by considering the use of rainwater collection and gray water systems as well as the fitting of water efficient toilets, taps, showers, dishwashers and washing machines.

External water use also needs to be reduced by encouraging the recycling of rainwater for irrigation purposes, car washing, etc.

- **Design site layouts to be climate change friendly.** On individual lots, building sites should be chosen to minimize wildfire and flood hazards and maximize passive heating and cooling. Minimize solar gain in summer; maximize natural ventilation, maximize native vegetation and take account of the increased risk of subsidence particularly in areas of clay soils. Local governments can use zoning codes and building codes to achieve these requirements.
- **Design outdoor spaces for a changing climate.** Ensure the design of surfaces take into account permeability, potential for causing dust and for soil erosion. Ensure the selection of vegetation with longer life (over 10 years) takes account of future climate change. Provide a rainwater collection/grey-water system for watering gardens and landscaped areas, use solar pumps, and ensure water features have minimal net water use. It is important to provide natural shade in outdoor spaces. Outside spaces should provide habitats to accommodate predicted changes in wildlife populations.

Use adaptive management strategies

- **Install water meters where possible.** Saving water can also be promoted by installing water meters. Water is as much a limited resource as electricity and natural gas, both of which, in existing properties, are generally metered.

Questions to ask local land use planners and resource managers regarding climate change

Awareness:

- Do you know how climate change could impact your area?

Analysis:

- Can you identify and assess the risks from climate change to your services?

Action:

- Do your current policies, strategies, and plans include provisions for the impacts of climate change?
- Are programs, plans and developments with a lifetime of more than 20 years required to factor in climate change?
- Have you briefed elected officials on any key risks arising from climate variability and long-term climate change?

Chapter 6: Messages and Messengers for Educating Yourself and Others

When reaching out to others in your group or planning team, there are often concerns and issues that make it challenging for them to understand and move forward in adapting to climate change. In our research of people's current perceptions and concerns regarding climate change, we found a number of obstacles our communication needed to overcome.

Some of the main obstacles we found:

- They may be very busy with their own work and adapting to climate change may seem like more work.
- They may not realize that climate change is occurring now and that significant changes will occur in the next twenty-five years—not 50-100 years later.
- They may believe that federal emissions policies need to be reversed and local actions are meaningless.
- They may associate climate change as an environmental issue and for them this can be off-putting.
- They may believe that understanding and adapting to climate change will take more resources than they have.
- They may think that adapting to climate change acknowledges that greenhouse gases are a cause—which is seen by them as still controversial.
- They may think the issue is hard to understand.
- They may believe we can't predict the weather now—let alone predict future climate changes.
- They do not see others in similar work, leading planning efforts to adapt to climate change—and they fear striking out on their own.

All of the concerns above can be addressed through basic messaging, education and discussion. Your goal is not to argue with ardent skeptics, but work with the reasoned center of people who are concerned, want to know more, and who are motivated to protect natural resources and rural communities in the face of change. We hope the following tips on messages, messengers and other tips for communication will help you reach this reasoned center of people to move forward in planning how to adapt to climate change in the Sierra.

Messages

The following are useful messages that can be at the core of your discussions about climate change:

- Scientists agree that the Sierra is warming up and snow is decreasing.
- Planning how to adapt to climate change now will be easier and cheaper than waiting for a crisis.
- Planning now will allow us to come up with win-win solutions that all stakeholders are happy with.
- Planning now will allow us to come up with solutions that protect our natural resources and our local economies.
- Planning for climate change impacts now will make a difference by leaving a visionary legacy of drinking water, flood control, and energy use and production while protecting natural resources for future generations.
- Be part of this effort to adapt to climate change and pass on the Sierra we love to your children and grandchildren.
- Adapting for climate change can be part of existing planning processes and will not add on additional work
- There are resources and scientific information available to help you plan on the local level.

Messengers

Depending upon who you are talking to about climate change impacts, it can be useful to have a variety of trusted sources helping you get your message across. For some audiences you may have all the credentials they would want. Other audiences may feel more comfortable with outside "expert" presenters from academia, government agencies, or other institutions. At the same time, the further outside your area you go for speakers, sometimes the more suspect by certain audiences. So always consider using local experts you can draw from to help in your educational outreach.

Local resource agency staff with a knowledge of climate change, scientists, water agency staff, local and state elected officials, community and church leaders and conservation group leaders will all be able to contribute information and add importance to the discussion. Sierra Nevada Alliance staff is also available to help.

The following section presents some California and Nevada based experts who may be available to help you educate your community and resource planners.

Potential Presenters

In carrying out its research into climate change, the Sierra Nevada Alliance has talked to many experts from universities, research institutes, water agencies, state and federal agencies and conservation groups. Although researchers and experts have extremely busy schedules, many of them realize how important it is that information about climate change reach a wide audience and have indicated that they would be able to come and speak to groups interested in this topic. The following experts indicated they are happy to be invited to address your group.

Sierra Nevada Alliance

P.O. Box 7989
South Lake Tahoe, CA 96158
(530)542-4546
(530)542-4570 fax
www.sierranevadaalliance.org
info@sierranevadaalliance.org

The Sierra Nevada Alliance has been protecting and restoring Sierra lands, water, wildlife, and communities since 1993. The Alliance has a Sierra Water & Climate Campaign. Campaign staff members are available to speak on climate change in the Sierra and adapting resource management planning.

John Andrew

Executive Manager for Climate Change

Department of Water Resources

901 P Street
Sacramento, CA 95814
(916)651-9657
jandrew@water.ca.gov

The Department of Water Resources is committed to preparing for the effects of global warming while finding new ways to reduce its contribution to climate change.

Jessica Brown

N. California Outreach Coordinator

California Interfaith Power and Light (CIPL)

1904 Franklin St. Suite 609
Oakland, CA 94612
(510)444-4078 ext.319
(510)444-4710 fax
Jessica@interfaithpower.org

CIPL is an interfaith organization that promotes environmental stewardship. They have a global warming campaign, providing religious congregations and practical solutions. They have a video and study guide.

Dan Cayan

Research Meteorologist

Scripps Institute of Oceanography

9500 Gilman Drive
La Jolla CA 92093
(858)534-4507
dcayan@ucsd.edu

Dan is a leader in the field of climate change research with vast knowledge of the subject, especially with regard to the Sierra.

Randy Kanouse
Special Assistant to the General Manager
East Bay Municipal Utility District
1127 Eleventh Street #414
Sacramento, CA 95814
(916)443-6948
rkanouse@ebmud.com

Randy represents EBMUD in Sacramento on state public policy issues and in the Legislature. EBMUD is a water and wastewater treatment utility which strives to recognize its public trust and environmental stewardship responsibilities in its policies and practices.

Carol A. Kennedy
Watershed Program Manager/ Forest Soil Scientist
United States Forest Service-Tahoe National Forest
(530)478-6239
(530)478-6109 fax
ckennedy@fs.fed.us

Carol has an extremely interesting power point presentation regarding climate change with an emphasis on forestry effects.

Connie Millar
Research Geneticist
United States Forest Service-Sierra Nevada Research Center
800 Buchanan Street
Albany, CA 94710
(510)559-6435
cmillar@fs.fed.us

Connie has been studying climate effects on Sierra Nevada forests that have occurred over the last 4000 years.

Fran Pavley
Natural Resources Defense Council
P.O. Box 1833
Agoura Hills, CA 91376
(818)865-1385(phone/fax)
franpavley@yahoo.com

As a former State Assembly member, Fran authored and passed California's two landmark global warming laws. AB 1493 requires new automobiles to reduce their greenhouse gas emissions and AB 32, "The Global Warming Solutions Act of 2006", places a cap on emissions and reductions back to 1990 levels. She is currently working with other states as a Senior Climate Advisor with NRDC (Natural Resources Defense Council).

Dr. Lisa Sloan
Director, Climate Change and Impacts Laboratory Dept. of Earth Sciences
University of California, Santa Cruz
1156 High St.
Santa Cruz, CA 95064 USA
(831)459-3693
lcsloan@es.ucsc.edu

Lisa has modeled climate change in California according to SWRCB hydrologic regions. She has an interesting power point presentation about climate change in California.

Greg Stock, Ph.D.
Geologist, Resources Management and Science
Yosemite National Park
5083 Foresta Road, PO Box 700
El Portal, CA 95318
(209)379-3263
greg_stock@nps.gov

Greg has a very interesting power point presentation titled "Melt Down: The Rise and Recent Fall, Sierra Nevada Glaciers".

Carl Zichella
Regional Staff Director of California, Nevada, Hawaii Regional Office
Sierra Club
1414 K Street, suite 500
Sacramento, CA 95815
(916)557-1100, ext 104
carl.zichella@sierraclub.org

Carl has been trained by Al Gore's Climate project to deliver his Inconvenient Truth slideshow. He is happy to do this for organizations and groups free of charge.

Chapter 7:
Resources, Reading & Websites

Climate change is an encompassing issue whose far-reaching effects are already being seen; for this reason, new resources and websites are becoming available nearly everyday. The Sierra Nevada Alliance has compiled a list of resources that we found useful and informative in creating the Sierra Climate Change Toolkit. We will frequently update this list and you can find an updated list on our website: www.sierranevadaalliance.org. Also, if you know of a great resource that you do not see listed here, please send it our way. We appreciate a helping hand in tracking down valuable materials.

MODELING SCENARIO TOOLS

The American River Watershed Institute has developed a Climate Change Scenario Calculator for Hydrologic Response in the Sierra Nevada. The Calculator is easy to use and can be easily loaded into a computer, with the addition of GIS data relevant to your watershed. The Calculator will help you understand what will happen in your watershed under different temperature scenarios. To download the calculator and instructions visit: www.arwi.us

Climate Data Plotting Page. Designed at Colorado State University this webpage lets you view climate data for your region over the last 130 years.
http://www.nrel.colostate.edu/~jhicke/climate_data/

FURTHER READING

California

How the West Will Warm

Natural Resources Defense Council 2004
Addresses all the issues in a comprehensible form--only on website.
http://www.nrdc.org/globalWarming/gww/fgww.asp

Our Changing Climate: Assessing the Risks to California

A Summary Report from the California Climate Change Center A. Luers. D.Cayan. G Franco, M.Hanemann and B.Croes July 2006 CEC-500-2006-077
The latest synthesis of Cal EPA's biennial science reports on the potential impact of continued global warming on certain sectors of the California economy.
http://www.climatechange.ca.gov/biennial_reports/2006report/index.html

Water

California Water Plan Update 2005: Volume 1 Chapter 4 Planning for an Uncertain Future *Department of Water Resources Bulletin 160-05 December 2005*

Describes how the State of California is adapting to the changing needs of decision makers, water managers and planners. It lays out a new analytical approach and multiple future scenarios.

http://www.waterplan.water.ca.gov/previous/cwpu2005/index.cfm

In Hot Water: Water Management Strategies to Weather Global Warming *Barry Nelson, Monty Schmitt, Robert Wilkinson, Ronnie Cohen, Noushin Ketabi for NRDC October 2006*

Concise summary of water-related problems and solutions.

www.nrdc.org

Progress on Incorporating Climate Change into Management of California's Water Resources *CA Department of Water Resources July 2006*

Extremely comprehensive report that presents progress and future directions on incorporating climate change science into management of California's water resources.

http://baydeltaoffice.water.ca.gov/climatechange/DWRClimateChangeJuly06.pdf

Water: The Potential Consequences of Climate Variability and Change for the Water Resources of the United States *Lead author Peter H. Gleick of the Pacific Institute 2000*

Despite the fact that this publication was written in 2000 it has extremely interesting sections on how we need to manage our water supply under new climate conditions.

www.pacinst.org/reports/national_assessment

Species Protection

Buying Time: A Users Manual for Building Resistance and Resilience to Climate Change in Natural Systems *2003 World Wildlife Fund*

An extremely thorough look at species protection under changing climate conditions in various ecosystem types around the world.

http://www.panda.org/news_facts/publications/index.cfm?uNewsID=8678

Ecological Impacts of a Changing Climate *Rebecca Shaw and PIER 2002*

Has a great section on the role of climate in ecosystem distribution and function. Talks about research needs and makes recommendations for action.

http://www.energy.ca.gov/reports/2003-04-16_500-03-025FA-III.PDF

Effects of Global Warming on Trout and Salmon in US Streams

Defenders of Wildlife and NRDC 2002

This is a somewhat complex but interesting paper concentrating on trout and salmon in the United States.

http://www.defenders.org/publications/fishreport.pdf

Building and Development

Adapting to Climate Change: a checklist for development; guidance on designing developments in a changing climate

London Climate Change Partnership. November 2005

Although this guide is written for developers and builder in the U.K. it's an excellent example of how to build capacity to adapt to climate change

www.london.gov.uk/climatechangepartnership/docs/adapting_to_climate_change.pdf

Fire

Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada

Sierra Nevada Alliance 2007

This report finds that unplanned growth makes it expensive and dangerous to protect Sierra communities from wildfire.

www.sierranevadaalliance.org

Forestry

University of Arizona Laboratory of Tree-Ring Research

Learn about tree rings, the science of dendrochronology, and try techniques for yourself.

http://www.ltrr.arizona.edu

Climate Change

Connie I. Millar, Pacific Southwest Research Station USDA Forest Service 2004

All about forestry and Climate Change. Has good section on what forest managers should be thinking about and lots of historical information.

http://www.fs.fed.us/psw/publications/documents/sp-001/sp-001.pdf

Economics

The Economics of Climate Change

Lawrence Goulder, Stanford University, NBER, and Resources for the Future 2005

An exploration into the uncertainties and consequences of climate change as well as a brief account of alternative economic approaches to measuring the benefits and costs of reducing GHG emissions.

http://iis-db.stanford.edu/pubs/21170/Goulder-Pizer_Palgrave_Article.pdf

Stern Review Report on the Economics of Climate Change

A 700-page report released on October 30, 2006 by economist Sir Nicholas Stern for the British government, which discusses the effect of climate change and global warming on the world economy.

http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

Other

Public Policy Institute of California Statewide Survey: Special Survey on the Environment

July 2006 Mark Baldassare Research Director and Survey Director

Interesting study of Californians' attitude to air quality, global warming, and energy.

http://www.ppic.org/main/publication.asp?i=659

USEFUL WEBSITES

General Climate Change Information

An Inconvenient Truth

www.climatecrisis.net

The website for Al Gore's "An Inconvenient Truth" has the scientific background for climate change, ways to take action and a downloadable educational companion guide to the film.

Earthguide: Global Warming

http://earthguide.ucsd.edu/globalchange/global_warming/01.html

Interesting background basics on global warming.

The Heat is Online

http://www.heatisonline.org/main.cfm

Website hosted by a retired journalist and a project of the Green House Network (http://www.greenhousenet.org/). It is a compilation of the latest news articles about global warming and climate change and other resources.

The Intergovernmental Panel on Climate Change

http://www//ipcc.ch

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations to assess scientific, technical and socio- economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is currently finalizing its Fourth Assessment Report "Climate Change 2007". The site has great information reports and graphics about global climate change written by the world's leading scientists.

Live Science

http://www.livescience.com/globalwarming/

Lots of good articles and multimedia presentations about global warming.

Natural Resources Defense Council

http://www.nrdc.org/globalWarming/default.asp

Everything from overviews, in-depth reports and up-to-the minute articles.

The Regeneration Project

http://www.theregenerationproject.org./

The regeneration project is an interfaith ministry devoted to deepening the connection between ecology and faith. One of their programs is to mobilize a national religious response to global warming while promoting renewable energy, energy efficiency and conservation.

Union of Concerned Scientists

http://www.ucsusa.org/global_warming/

A wealth of understandable information about global warming.

U.S. E.P.A. Climate Change website

http://epa.gov/climatechange/

The EPA's Climate Change Site offers a huge amount of comprehensive and accessible information on climate change for communities, individuals, business, states and localities, and governments. Within the site there is some excellent information for teachers to use in classrooms.

Western Regional Climate Center

www.wrcc.dri.edu

One of six regional climate centers in the United States. The Regional Climate Centers Program is administered by the National Oceanic and Atmospheric Administration and funded through the NOAA Cooperative Institute for Atmospheric Sciences and Terrestrial Applications (CIASTA).

California Climate Information

California Climate Action Registry

http://www.climateregistry.org/ABOUTCLIMATECHANGE/

A useful site with information about climate change in California.

CA Climate Change.net

http://caclimatechange.net/

This is a working site that offers information on California's actions to deal with climate change. It is intended to offer up-to-date information from scientific communities, industries, policy and legislative bodies and media coverage on climate change for people working in this field.

State of California Climate Change Portal

http://www.climatechange.ca.gov/index.html

A valuable website on the work being done on climate change by the State of California. This includes reports and research on topics such as wildfires, health impacts, water supply and agriculture among many others.

Union of Concerned Scientists

http://www.climatechoices.org/ca/index.html

A compilation of excellent information and reports about climate change impacts on California.

Your Carbon Footprint

www/epa.gov/climatechange/emissionsind_calculator.html

www.climatecrisis.net/takeaction/carboncalculator.html

Find out how you are impacting the planet at these two carbon footprint calculator sites.

Other

Cirmount: Consortium for Integrated Climate Research in Western Mountains

http://www.fs.fed.us/psw/cirmount

The Consortium for Integrated Climate Research in Western Mountains (CIRMOUNT) is a collaborative, interdisciplinary consortium dedicated to understanding climates and ecosystems of western North American mountains. The website brings together information, publications, reports and presentations from researchers from diverse disciplines and institutions.

City of Aspen Canary Initiative

www.aspenglobalwarming.com

In March of 2005, the City of Aspen adopted a plan to aggressively begin reducing global warming emissions. This initiative is a great example of the sort of action a city can take to reduce global warming pollution; inform the public about impacts from, and solutions for global warming; and to advocate for action on a regional, state, and national level.

Paleo-climate and climate change research group website

Dept of Earth Sciences UC Santa Cruz.

http://www.es.ucsc.edu/~lcsloan/

Articles and reports by leading scientists and researchers.

RealClimate

www.realclimate.org

RealClimate is a commentary site on climate science by working climate scientists for the interested public and journalists. They provide a quick response to developing stories and provide the context sometimes missing in mainstream commentary.

Chapter 8: Conclusion

Climate scientists agree that the world's climate is changing and this presents many challenges and opportunities. At times, the magnitude and speed at which these predicted changes are occurring can be overwhelming and depressing. At the same time, there has never been a greater motivation for our culture to change current practices to understand and respect how nature works and to shape our activities to be in balance with natural systems.

We hope the information and resources presented in this toolkit empower you to take a lead in your local resource planning efforts, to educate your fellow planners and ensure future planning adapts to this new future. This toolkit is geared to having people take action today to plan for this new future in the belief that planning now rather than waiting is in the best interest of everyone. With an encompassing issue like climate change, we understand that it is sometimes hard to visualize or identify possible solutions that we can take as individuals or as part of a group.

For this reason we have designed the pledge; to serve as a reminder of the actions that we can take as individuals or as part of a group to address our changing climate and environment.

My Climate Change Pledge is designed for individual personal action. The premise of this pledge is to inspire each of us to reduce our individual carbon emissions and minimize our ecological footprint. Through twelve simple actions (further explored in Chapter 3) you can quantify the difference you are making through your everyday decisions. So please take the My Climate Change Pledge today and reduce your personal greenhouse gas emissions.

The Climate Change Adaptation Pledge is geared toward groups/agencies and entities involved in resource management planning. Adapting to climate change does not require a separate 'process'. Adaptation can be a part of existing resource planning efforts. Adapting planning efforts now will prove to be easier and cheaper, and produce win-win solutions that will benefit our natural world and economy. The seven guiding principles (discussed in Chapter 4) help ensure that our communities are resilient in facing the changes brought on by climate change.

By taking either or both of these pledges, you are vowing to be a leader and encourage the following activities whenever given the opportunity. In return the Sierra Nevada Alliance will work to help you and your organization with tools, resources, and/or support. By sending back the completed pledge you will also receive new publications and the latest news on what other resource planners are doing to address climate change.

Take action, make a difference, and sign the pledge today.

My Climate Change Pledge

10 simple things I can do to reduce emissions at home, while the Sierra Nevada Alliance works to reduce emissions and adapt to Climate Change in the Sierra Nevada region

1. **Walk, Bus, Bike, Ski vs. Drive**
   You'll save one pound of carbon dioxide for every mile you don't drive.
2. **Drive Smart**
   Check your tires – keeping your tires properly inflated can improve gas mileage by more than 3%.
3. **Conserve Energy**
   Replace light bulbs with compact fluorescent. By replacing one regular light bulb with a compact florescent light bulb you will save 150 pounds of carbon dioxide a year.
4. **Choose Clean Power**
   Call your local utility and sign-up for renewable energy. If they don't offer it, ask them why.
5. **Conserve Water**
   Turn water off while you brush your teeth, or as you are scrubbing your dishes.
6. **Plant a Tree**
   A single tree will absorb one ton of carbon dioxide over its lifetime.
7. **Reduce-Reuse-Recycle**
   Save 1,200 pounds of carbon dioxide by cutting your garbage by 10%.
8. **Educate Yourself and Pass on the News**
   Keep up with the latest news on Climate Change and Adaptation, and tell someone else what you learned.
9. **Take The Ecological Footprint Quiz**
   The quiz is based on national consumption averages and is meant to give you an idea of your Ecological Footprint relative to other people in the country. Visit **www.ecofoot.org**.
10. **Visit Our Website For More Information on The Climate Change Campaign!**
    www.sierranevadaalliance.org

Because my actions can curb global warming, this year I pledge to:_____

_____

Please call or email if you have any questions or would like to schedule a Free Climate Change Presentation for your group.
Contact the Sierra Nevada Alliance at 530.542.4546 or email us at info@sierranevadaalliance.org

Individual Climate Change Pledge

I pledge to be a leader and to reduce my climate change footprint. I will do my best in reducing emissions by implementing the 10 simple things whenever I can.

_____
Signature

Contact Information

Name_____Affiliation_____

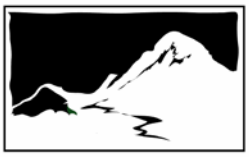
Email _____ Phone_____❒cell ❒home ❒work

Address/City/Zip _____

_____

❒Yes, please send me the Sierra Nevada Alliance Climate Change email, news, and other campaign information!

Sierra Water & Climate Change Adaptation Pledge



SIERRA NEVADA ALLIANCE

Keeping light in the range.

Climate change is significantly impacting wildlife, water supply, water quality, ecosystem health, and rural communities. The Sierra snow pack is predicted to decrease by 25-40% in the next twenty to forty years and changes in snow pack and ecosystems are already being seen. We must reduce greenhouse gas emissions and make water and energy conservation a priority to prevent catastrophic climate change! In addition to reducing emissions, we must adapt to these changes in ways that ensure we protect natural resources and vibrant communities.

I pledge to be a leader and encourage the following activities when given the opportunity:

1. **Educate myself and others regarding global, national, statewide, and regional impacts of climate change.**
2. **Identify possible future changes through modeling.**
3. **Use adaptive management strategies to maintain flexibility.**
4. **Monitor and track changes in weather, hydrology and ecosystems in my community, watershed and/or region.**
5. **Promote the resiliency of existing ecosystems and minimize stressors to these systems.**
6. **Prioritize projects that will succeed under multiple scenarios.**
7. **Integrate and coordinate local efforts.**

I will coordinate with the Sierra Nevada Alliance to fulfill my pledge. The Sierra Nevada Alliance will provide assistance, regular communications and resources with the latest information, tools, and experts that can help my effort.

Signature: _____

Contact Information

Name _____

Organization _____

I am involved with the following resource planning efforts:

❒Water ❒Land-Use Planning ❒Hydropower Relicensing ❒Watershed
❒Forestry Management ❒Flood Protection ❒Fish & Wildlife Management
❒Other _____

Email _____

Phone _____❒ cell ❒ home ❒ work

Address/City/Zip _____

www.sierranevadaalliance.org / 530-542-4546 / joan@sierranevadaalliance.org / PO Box 7989 S LakeTahoe, CA 96158

Send us Comments and New Resources for Future Toolkits

This is the second edition of the Sierra Climate Change Toolkit and we welcome your input to make our website and the next edition even more useful. So please send us your comments on what is helpful or useless. Please forward tools, names of presenters, messages and any tips or information you think would be good for others planning for climate change to know about. We can put many new resources on our website version of the toolkit quickly and hope to raise the resources to issue new printed editions semi-annually.

Contact the Sierra Nevada Alliance at:

Email: info@sierranevadaalliance.org
Web: www.sierranevadaalliance.org
Phone: 530.542.4546
Address: P.O. Box 7989, South Lake Tahoe, CA 96158

Think Globally, Act Locally

The Sierra Nevada Alliance is determined to protect and restore the Sierra's natural resources and rural communities for future generations. We are confident that by working together at the local, regional, state, national and global level that we can achieve this mission. Our organization was founded by a network of groups who have saved many of the Sierra's special places because they did not wait for others to do it for them. It is the history of 'taking the initiative', leadership and hutzpah that gives us hope in the face of such global changes. Together we can thrive in a world of diversity, abundant life and balance, if we choose.

Endnotes

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