

Third Annual Climate Change Research Conference

**Climate Scenarios, Impacts, and
Adaptation Options in California:
Status of Research Activities**

September 13 – 15, 2006

The Radisson Hotel Sacramento
Sacramento, California



CONFERENCE PROGRAM

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Third Annual Climate Change Research Conference

*Climate Scenarios, Impacts, and Adaptation Options
in California: Status of Research Activities*

SEPTEMBER 13 – 15, 2006

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Arnold Schwarzenegger,
Governor

September 13, 2006
Sacramento, California

Dear Colleagues,

On behalf of the California Energy Commission and the California Environmental Protection Agency, we welcome you to the Third Annual Climate Change Research Conference, *Climate Scenarios, Impacts, and Adaptation Options in California: Status of Research Activities*.

Since our 2005 conference, scientific evidence has continued to mount on the reality and risks of global climate change, both in California and around the world. In recognition of these risks, several states and foreign countries, as well as innovative private firms, are pursuing aggressive steps in reducing greenhouse gas emissions while undertaking prudent preparations for dealing with climate change impacts.

California has emerged as a leader on each of these fronts: scientific research, greenhouse gas mitigation, and impact adaptation assessment. Following Governor Schwarzenegger's historic 2005 announcement of emissions reductions targets, our agencies, led by the Climate Action Team, produced a landmark report on potential California climate change impacts and greenhouse gas mitigation strategies. This effort was a first step in a multi-year, comprehensive effort to identify and implement the transition strategy of the California energy system and economy to a climate-friendly, low-emissions configuration for the coming decades.

This conference will present recent results of the state's large and expanding portfolio of publicly sponsored scientific and technical research on regional climate change, emissions measurement and management, and adaptation planning. This work represents a deepening intellectual foundation supporting California's policymakers in meeting the challenge of climate change, in managing its impacts on the state's natural and socioeconomic systems, and in contributing to the accelerating worldwide effort to reduce greenhouse gas emissions.

Your participation will both ensure the success of this event and assist us in continuing to build our research program. We are very pleased to welcome you to the 2006 conference.

Sincerely,

ARTHUR H. ROSENFELD
Commissioner
California Energy Commission

JAMES D. BOYD
Vice Chair
California Energy Commission

LINDA ADAMS
Secretary
California Environmental
Protection Agency

CONFERENCE AGENDA

AT A GLANCE

WEDNESDAY SEPTEMBER 13	THURSDAY SEPTEMBER 14	FRIDAY SEPTEMBER 15
<p>1:00 PM Welcome and Introduction <i>Vice Chair James Boyd, California Energy Commission</i></p> <p>1:20 PM California Climate Policy Landscape <i>Deputy Secretary Anne Baker, California Environmental Protection Agency</i></p> <p>2:20 PM Is There Still Time to Avoid Disastrous Human-Made Climate Change? <i>Keynote Speaker: James Hansen, National Aeronautics and Space Administration</i></p> <p>3:50 PM Inventory Methods and Options to Reduce GHG Emissions <i>Session Chair: Steve Shaffer, California Department of Food and Agriculture</i></p>	<p>8:00 AM Regional Climate Modeling <i>Session Chair: Nehzat Motallebi, California Air Resources Board</i></p> <p>9:00 AM WESTCARB: Carbon Sequestration <i>Session Chair: Lawrence Myer, California Energy Commission</i></p> <p>10:20 AM Aerosols and Regional Climate <i>Session Chair: Guido Franco, California Energy Commission</i></p> <p>11:45 AM Recent Advances in Detection and Attribution Studies <i>Keynote Speaker: Benjamin Santer, Lawrence Livermore National Laboratory</i></p> <p>1:10 PM Impact and Adaptation Studies I <i>Session Chair: Amy Luers, Union of Concerned Scientists</i></p> <p>3:20 PM Impact and Adaptation Studies II <i>Session Chair: Michael Anderson, California Department of Water Resources</i></p> <p>5:20 PM Poster Session <i>Session Chairs: Edward Vine, California Institute for Energy and Environment; and Brian Ellis, California Energy Commission</i></p>	<p>8:00 AM Ecology and Climate Change <i>Session Chair: Douglas Wickizer, California Department of Forestry and Fire Protection</i></p> <p>10:45 AM Impact and Adaptation Studies III <i>Session Chair: Philip B. Duffy, Lawrence Livermore National Laboratory</i></p> <p>12:15 PM From the IPCC Third Assessment Report to the Fourth: The Relevance of Science <i>Keynote Speaker: Rajendra K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change</i></p> <p>1:45 PM Concluding Remarks <i>Deputy Director Martha Krebs, Energy Research and Development Division, California Energy Commission</i></p>

CONFERENCE AGENDA

WEDNESDAY, SEPTEMBER 13

INTRODUCTION

1:00 PM – 1:20 PM

Welcome and Introduction

Vice Chair James Boyd (California Energy Commission)

1:20 PM – 1:50 PM

California Climate Policy Landscape

Deputy Secretary Anne Baker (California Environmental Protection Agency)

1:50 PM – 2:20 PM

Climate Change Research and PIER: Status and Future Activities

Kelly Birkinshaw and Guido Franco (California Energy Commission)

2:20 PM – 3:30 PM

Is There Still Time to Avoid Disastrous Human-Made Climate Change?

Keynote Speaker: James Hansen (National Aeronautics and Space Administration)

3:30 PM – 3:50 PM B R E A K

INVENTORY METHODS AND OPTIONS TO REDUCE GREENHOUSE GAS (GHG) EMISSIONS

Session Chair: Steve Shaffer (California Department of Food and Agriculture)

3:50 PM – 4:10 PM

Measurement of GHG Emissions from Dairy Farms

Frank Mitloehner (University of California, Davis)

4:10 PM – 4:30 PM

Developing a Biogeochemical Process-Based Model for Estimating GHG Emissions from Dairy Farms

William Salas (Applied Geosolutions)

4:30 PM – 4:50 PM

Regional Projections of Net GHG Emissions and Reductions in California Agriculture

Johan Six (University of California, Davis)

4:50 PM – 5:10 PM

Economic Analysis of Reduction Options for Growers

Richard Howitt (University of California, Davis)

THURSDAY, SEPTEMBER 14

REGIONAL CLIMATE MODELING

Session Chair: Nehzat Motallebi (California Air Resources Board)

8:00 AM – 8:20 AM

Modeling Effects of Land Use Changes on California's Climate

Lisa Sloan (University of California, Santa Cruz)

8:20 AM – 8:40 AM

Can Regional Models Capture Precipitation and Temperature Extremes? Performance of Regional Spectral Model (RSM) in a Five-Decade Re-analysis

Alexander Gershunov (Scripps Institution of Oceanography)

8:40 AM – 9:00 AM

Translating Climate Change Model Uncertainty into Impacts Models

Michael Dettinger (Scripps Institution of Oceanography)

WESTCARB: CARBON SEQUESTRATION

Session Chair: Lawrence Myer (California Energy Commission)

9:00 AM – 9:30 AM

Removing Hazardous Fuels from Forests to Reduce Greenhouse Gas Emissions from Uncharacteristically Severe Wildfires

Sandra Brown and John Kadyszewski (Winrock International)

9:30 AM – 10:00 AM

Pilot Testing of CO₂ Sequestration in Deep Underground Geological Formations in California

Sally Benson (Lawrence Berkeley National Laboratory)

10:00 AM – 10:20 AM B R E A K

AEROSOLS AND REGIONAL CLIMATE

Session Chair: Guido Franco (California Energy Commission)

10:20 AM – 10:50 AM

Collection and Analysis of Aerosols and Rainwater Samples During SUPRECIP-2

Odelle Hadley (Scripps Institution of Oceanography) and Steven Cliff (University of California, Davis)

CONFERENCE AGENDA

THURSDAY, SEPTEMBER 14

10:50 AM – 11:20 AM

Aerosols Suppressing Precipitation in the Sierra Nevada: Results of the 2006 Winter Field Campaign

Daniel Rosenfeld (The Hebrew University of Jerusalem)

11:20 AM – 11:45 AM

Numerical Study of the Effects of Aerosols and Irrigation on Snow, Rain, and Regional Climate in California

Mark Jacobson (Stanford University)

11:45 AM – 1:10 PM LUNCH

Recent Advances in Detection and Attribution Studies

Keynote Speaker: Benjamin Santer (Lawrence Berkeley National Laboratory)

IMPACT AND ADAPTATION STUDIES I

Session Chair: Amy Luers (Union of Concerned Scientists)

1:10 PM – 1:40 PM

Climate Scenarios Analysis: Some Critical Elements for California's Future Pathway

Daniel Cayan (Scripps Institution of Oceanography)

1:40 PM – 2:10 PM

California's Dynamic Mosquito Populations: Effects of Climate on Encephalitis and West Nile Outbreaks

William Reisen (University of California, Davis)

2:10 PM – 2:40 PM

Potential Air Quality Impacts

Michael Kleeman (University of California, Davis)

2:40 PM – 3:00 PM

Potential Agricultural Impacts and Adaptation Options

Dennis Baldocchi (University of California, Berkeley)

3:00 PM – 3:20 PM BREAK

IMPACT AND ADAPTATION STUDIES II

Session Chair: Michael Anderson (California Department of Water Resources)

3:20 PM – 3:40 PM

Modeling Coastal Evolution in Southern California: Geomorphic Response to Sea Level Rise and Changes in Wave Climate

Peter Adams (University of Florida)

3:40 PM – 4:00 PM

Projecting Inundation Due to Sea Level Rise in the San Francisco Bay and Delta

Noah Knowles (United States Geological Survey)

4:00 PM – 4:20 PM

Preparing for the Impacts of Climate Change in California: How Ready Is the Coastal Sector?

Susanne Moser (National Center for Atmospheric Research (NCAR) Institute for the Study of Society and Environment)

4:20 PM – 4:40 PM

Water Supply Adaptation and Impacts for Extreme Droughts and Climate Change

Jay Lund (University of California, Davis)

4:40 PM – 5:00 PM

Impacts of High-Elevation Hydropower Units: Upper American River

Sebastian Vicuña (University of California, Berkeley)

5:00 PM – 5:20 PM

Estimation of Economic Impacts of Climate Change: Preliminary Results

Michael Hanemann (University of California, Berkeley)

5:20 PM – 7:30 PM

Poster Session

Session Chairs: Edward Vine (California Institute for Energy and Environment) and Brian Ellis (California Energy Commission)

CONFERENCE AGENDA

FRIDAY, SEPTEMBER 15

ECOLOGY AND CLIMATE CHANGE

Session Chair: Douglas Wickizer (California Department of Forestry and Fire Protection)

8:00 AM – 8:30 AM

Climate Change Impacts on Ecosystem Structure: Lessons from Paleocology

Elizabeth Hadly (Stanford University)

8:30 AM – 9:00 AM

Movement of the Conifer Belt on the Sierra Nevada in the Last 100 Years

James Thorne (University of California, Davis)

9:00 AM – 9:30 AM

Yosemite Then and Now: The Grinnell Legacy

Christopher Conroy (University of California, Berkeley)

9:30 AM – 10:00 AM

Complex Responses of High-Elevation Forests in the Sierra Nevada to Climate Change: Past and Future

Constance Millar (USDA Forest Service)

10:00 AM – 10:30 AM

Dynamic Modeling of Climate Change Impacts on California Endemic Trees

Lee Hannah (Center for Applied Biodiversity Science at Conservation International)

10:30 AM – 10:45 AM B R E A K

IMPACT AND ADAPTATION STUDIES III

Session Chair: Philip B. Duffy (Lawrence Livermore National Laboratory)

10:45 AM – 11:15 AM

Climate-Hydrology Forecasts and Risk-Based Reservoir Management in Northern California: Design and Initial Tests of the Real-Time INFORM System

Nicolas E. Graham (Hydrologic Research Center/Scripps Institution of Oceanography)

11:15 AM – 11:45 AM

An Epidemiologic Study of Temperature and Mortality in California: Implications for Climate Change

Rupa Basu (California Office of Environmental Health Hazard Assessment)

11:45 AM – 12:15 PM

Climate and Forest Wildfire in the Western United States: Recent Trends and Projections

Anthony Westerling (University of California, Merced)

12:15 PM – 1:45 PM LUNCH

From the IPCC Third Assessment Report to the Fourth: The Relevance of Science

Keynote Speaker: Rajendra K. Pachauri (Chairman of the Intergovernmental Panel on Climate Change)

1:45 PM – 2:00 PM

Concluding Remarks

Deputy Director Martha Krebs (Energy Research and Development Division, California Energy Commission)



JAMES D. BOYD
 VICE CHAIR, CALIFORNIA ENERGY COMMISSION

James D. Boyd was appointed to the California Energy Commission on February 6, 2002, and as the Vice Chair on June 16, 2006. Vice Chair Boyd presides over the Energy Commission's Transportation and Fuels Committee and oversees Climate Change and International Export programs. He also presides over the Natural Gas Committee, which includes the Energy Commission's work on liquefied natural gas (LNG). He was the Associate Member of the committee overseeing preparation of the Energy Commission's *2005 Integrated Energy Policy Report*. He is also the Associate Member of the Legislative and Intergovernmental Committee.

Vice Chair Boyd serves as the state's liaison to the Nuclear Regulatory Commission and as California's representative on the Border Governors' Conference Energy Worktable. He also serves as the Energy Commission's representative on the Steering Team of the California Fuel Cell Partnership and the Board of Directors of WestStart/CALSTART, a California-based not-for-profit advanced transportation technology consortium, and is on the Board of Advisors of the Institute of Transportation Studies at the University of California, Davis. He served on the Governor's

Hydrogen Highway Network Implementation Advisory Panel and presently serves on the Governor's Climate Action Team. He currently leads the Bio-Energy Interagency Working Group that developed and is now implementing the Governor's Bio-Energy Action Plan. He is overseeing the Commission's efforts to develop the alternative transportation fuels plans requested by the Governor and Legislature.

Prior to his appointment to the Energy Commission, Vice Chair Boyd was Deputy Secretary and Chief of Staff of the California Resources Agency. He created and chaired the state's first Joint Agency Climate Change Team and the state's Natural Gas Working Group. He served 15 years as the Chief Executive Officer of the California Air Resources Board (ARB), directing the nation's largest state air pollution control program. During this period, ARB led the nation in establishing new pollution control programs for motor vehicles and fuels, toxic air contaminants, consumer products, and industrial and area sources. A California native, Vice Chair Boyd received his B.S. in business administration from the University of California, Berkeley.



ANNE E. BAKER
 DEPUTY SECRETARY FOR EXTERNAL AFFAIRS,
 CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

In 2004, Governor Schwarzenegger appointed Anne Baker as Deputy Secretary for External Affairs for the California Environmental Protection Agency (Cal/EPA). As Deputy Secretary, she assists the Secretary in shaping and implementing the Governor’s environmental policy.

Ms. Baker has spent more than 25 years dealing with public policy issues at the state and local levels, with a primary emphasis on air and water quality. For the last eight years, she served as staff in the California Assembly for resource conservation and environmental protection policy and budget issues. Most recently, Ms. Baker was the primary staff member for AB 1493, the landmark greenhouse gas (GHG) emission reduction legislation that requires GHG reductions from automobiles.

Prior to moving to Sacramento, Ms. Baker served as senior advisor to the General Manager for the Metropolitan Water District (MWD) of Southern California, where she developed its first strategic plan and Blue Ribbon Task Force. Before joining

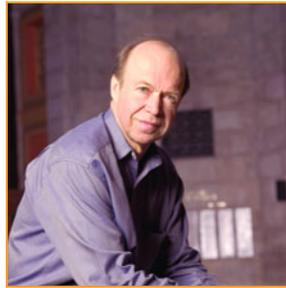
MWD, Ms. Baker was Director of Environmental Planning at the Southern California Association of Governments for five years. From 1986–1987 she was Deputy Controller for Taxation and served as a member of the State Board of Equalization.

During 1983, Ms. Baker worked in regulatory and public affairs at Pacific Telesis Corporation, where a portion of her duties included providing regulatory support to the first cellular telephone company in Los Angeles.

Prior to moving to California, she was an elected member of the Maryland House of Delegates from Howard County, Maryland.

Ms. Baker graduated in 1983 from the Kennedy School of Government, Harvard University, with a master’s degree in public administration.

Ms. Baker and her husband, Bill Stall, a Pulitzer Prize–winning journalist at the *Los Angeles Times*, live in Sacramento.



JAMES E. HANSEN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

James E. Hansen heads the National Aeronautics and Space Administration's (NASA) Goddard Institute for Space Studies (GISS) in New York City, a division of the Goddard Space Flight Center's Sciences and Exploration Directorate in Greenbelt, Maryland. He is also an Adjunct Professor of Geology at Columbia University's Earth Institute.

Dr. Hansen was trained in physics and astronomy in the space science program of Dr. James Van Allen, at the University of Iowa. His early research on the properties of Venus's clouds led to their identification as sulfuric acid. Since the late 1970s, he has worked on studies and computer simulations of Earth's climate, for the purpose of understanding the human impact on global climate. Dr. Hansen is best known for his testimony on climate change to congressional committees in the 1980s, which helped raise broad awareness of the global warming issue.

He was elected to the National Academy of Sciences in 1995 and, in 2001, received the Heinz Award for the Environment and the American Geophysical Union's Roger Revelle Medal.

In 1963, Dr. Hansen received his B.A. with highest distinction in physics and mathematics from the University of Iowa. He participated in the NASA Graduate Traineeship from 1963–1966, and received an M.S. in astronomy from the University of Iowa in 1965. Dr. Hansen was a visiting student at the Institute of Astrophysics, University of Kyoto, and the Department of Astronomy, Tokyo University, Japan, from 1965–1966. He received his Ph.D. in physics from the University of Iowa in 1967. Except for 1969, when he was a National Science Foundation postdoctoral scientist at Leiden Observatory under Professor H. C. van de Hulst, he has spent his postdoctoral career at NASA GISS.



BENJAMIN D. SANTER

LAWRENCE LIVERMORE NATIONAL LABORATORY

Benjamin D. Santer is an atmospheric scientist at Lawrence Livermore National Laboratory (LLNL). Dr. Santer's research focuses on such topics as climate model evaluation, the use of statistical methods in climate science, and identification of natural and anthropogenic "fingerprints" in observed climate records. His early research on the climatic effects of combined changes in greenhouse gases (GHG) and sulfate aerosols contributed to the historic "discernible human influence" conclusion of the 1995 report by the Intergovernmental Panel on Climate Change (IPCC). He spent much of the last decade addressing the contentious issue of whether model-simulated changes in tropospheric temperature are in accord with satellite-based temperature measurements. His recent work has attempted to identify anthropogenic fingerprints in a number of different climate variables, such as tropopause height, the temperature of the stratosphere and troposphere, and ocean surface temperatures in hurricane formation regions.

Dr. Santer holds a Ph.D. in climatology from the University of East Anglia, England, in 1987 where he studied under Professor Tom

Wigley. After completion of his Ph.D., he spent five years at the Max Planck Institute for Meteorology in Germany, working with Professor Klaus Hasselmann on the development and application of climate fingerprinting methods. In 1992, Dr. Santer joined Professor Larry Gates at LLNL's Program for Climate Model Diagnosis and Intercomparison.

Dr. Santer served as convening lead author of the climate change detection and attribution chapter of the 1995 IPCC report. More recently, he was the convening lead author of a key chapter of the U.S. Climate Change Science Program's report *Temperature Trends in the Lower Atmosphere*.

His awards include the Norbert Gerbier-MUMM International Award (1998), a MacArthur Fellowship (1998), the U.S. Department of Energy's E. O. Lawrence Award (2002), and a Distinguished Scientist Fellowship from the U.S. Department of Energy, Office of Biological and Environmental Research (2005). He and his son Nicholas live in San Ramon, and enjoy rock climbing and exploring California.



RAJENDRA K. PACHAURI

THE ENERGY AND RESOURCES INSTITUTE
CHAIRMAN OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Rajendra K. Pachauri has been the chief executive of The Energy and Resources Institute (TERI) since 1981, first as Director, and since April 2001, as Director-General. In April 2002, Dr. Pachauri was elected as Chairman of the Intergovernmental Panel on Climate Change (IPCC), which was established by the World Meteorological Organization and the United Nations Environment Programme in 1988.

Dr. Pachauri has a Ph.D. in industrial engineering and a Ph.D. in economics. He has held faculty positions at North Carolina State University, West Virginia University, the Administrative Staff College of India, and most recently, Yale University.

Dr. Pachauri has been on several international and national committees, including the Economic Advisory Council to the Prime Minister of India and the Advisory Board on Energy (ABE), which reported directly to the Prime Minister of India; he also served as Senior Advisor to the Administrator of the United Nations Development Programme. He has been President (1988)

and Chairman (1989–1990) of the International Association for Energy Economics (IAEE), and since 1992, as the President of the Asian Energy Institute.

Dr. Pachauri was awarded the Padma Bhushan, one of the highest civilian awards in India, conferred by the President of India. In September 1999, he was appointed Chairman of the Darjeeling Himalayan Railway Heritage Foundation. Earlier, in April 1999, he was appointed Member of the Board of Directors of the Institute for Global Environmental Strategies, Japan, and continues to hold this appointment. He is President of the India Habitat Centre, New Delhi; a member of the Board of Trustees of the India International Centre; and Vice President of the Bangalore International Centre. Dr. Pachauri was recently decorated as an Officer of the Legion d'Honneur by the President of France.

Dr. Pachauri is the author of 21 books and several published papers and articles.

PETER ADAMS

University of Florida

Peter Adams received a B.S. degree in chemical engineering and geosciences from Pennsylvania State University, his M.S. in geosciences from Pennsylvania State University, and his Ph.D. in earth sciences from the University of California, Santa Cruz. He worked as a postdoctoral scholar at Scripps Institution of Oceanography during 2005–2006. Dr. Adams is currently a Research Scientist in the Department of Geological Sciences at the University of Florida. His research focuses on “real-time” instrumentation of the coastal landscape to document rates and magnitudes of geomorphic processes, and numerical modeling of coastal evolution. In collaboration with researchers at Scripps, Dr. Adams uses numerical models of wave transformation, sediment transport, and sea cliff retreat to simulate coastal change in response to sea level rise and wave climate variation along California’s coast.

MICHAEL ANDERSON

California Department of Water Resources

Michael Anderson began working in the Department of Water Resources (DWR) Division of Flood Management Forecasting Section in July 2005. Dr. Anderson came to DWR after extensive graduate, postgraduate, and consulting work with Professor M. Levent Kavvas of the University of California (UC), Davis. His research includes a variety of studies involving hydrologic and atmospheric models. He is also an experienced instructor and is currently serving as the acting state climatologist. Dr. Anderson received his Ph.D. and M.S. in civil and environmental engineering from UC Davis. He received his B.S. in civil engineering from Colorado State University in 1991.

DENNIS BALDOCCHI

University of California, Berkeley

Dennis Baldocchi is a Professor of Biometeorology at the University of California (UC), Berkeley, and Chair of the Ecosystem Sciences Division of UC Berkeley’s Department of Environmental Science, Policy and Management. Dr. Baldocchi’s scientific interests cover biosphere-atmosphere interactions, canopy micrometeorology, and agriculture and forest meteorology. His research focuses on modeling and measuring the biophysical processes that control water vapor, carbon dioxide, atmospheric trace gases, and energy interactions between vegetation

canopies and the atmosphere. He is also interested in understanding and quantifying climate trends in California’s agricultural regions. Dr. Baldocchi serves as an editor of *Global Change Biology*, is a member of the editorial review boards of *Agricultural and Forest Meteorology*, *Boundary Layer Meteorology*, and *Plant, Cell and Environment*, and serves the Faculty of 1000. He is also coordinator of the global FLUXNET project and is principal investigator of an AmeriFlux project on the carbon and water flux of an oak savanna near Lone, California.

RUPA BASU

California Office of Environmental Health Hazard Assessment

Rupa Basu is a research scientist at the Office of Environmental Health Hazard Assessment’s (OEHHA) Air Pollution Epidemiology section. Before joining OEHHA, Dr. Basu worked at the U.S. Environmental Protection Agency. She received her Ph.D. in environmental and occupational epidemiology from The Johns Hopkins University School of Public Health and her Masters in Public Health with an emphasis in environmental health from the University of California, Los Angeles. Dr. Basu’s research has focused on various epidemiologic methods to examine environmental exposures, including estimating the independent effects of air pollution and temperature on mortality, assessing the effects of heat exposure on the elderly, and examining the effects of air pollution on birth weight. She has also published a review on the health effects of indoor nitrogen dioxide from exposure to gas stoves.

SALLY M. BENSON

Lawrence Berkeley National Laboratory

Sally Benson, a staff scientist in the Earth Sciences Division at Lawrence Berkeley National Laboratory (LBNL), has spent the last seven years developing the scientific foundations for storage of carbon dioxide in deep geological formations. Dr. Benson, as coordinating lead author, recently completed Chapter 5 of the Intergovernmental Panel on Climate Change’s *Special Report on Carbon Dioxide Capture and Storage*. She is also the project director for the GEO-SEQ Project, principal investigator for the Zero Emissions Research and Technology Center at LBNL, and geological pilot test leader for the WESTCARB Regional Sequestration Partnership. Prior research has focused on a wide range of topics related to environmental remediation and geothermal energy production. From 1993 to 2005, Dr. Benson

held a number of senior management positions at Lawrence Berkeley Laboratory, including Deputy Director for Operations, Associate Laboratory Director for Energy Sciences, and Earth Sciences Division Director. Dr. Benson received her B.A. from Barnard College and her M.S. and Ph.D. from the University of California, Berkeley.

KELLY BIRKINSHAW

California Energy Commission

Kelly Birkinshaw is the Environmental Program Manager for the Public Interest Energy Research (PIER) Program of the California Energy Commission. He is responsible for a \$50 million research project portfolio addressing energy and the environment in the areas of air quality, water resources, land use/habitat, and climate change. As part of an integrated approach to climate change research, Mr. Birkinshaw established a virtual research center for regional-specific studies. This center, known as the California Climate Change Center, has core research activities at the Scripps Institution of Oceanography and University of California (UC), Berkeley. He is Deputy Director of the West Coast Carbon Sequestration Partnership and is currently creating an air quality research program at the Center for Sustainable Urban Development at UC Riverside. Mr. Birkinshaw received a B.S. and M.S. in chemical engineering from UC Davis.

SANDRA BROWN

Winrock International

Sandra Brown has a Ph.D. in systems ecology from the Department of Environmental Engineering Sciences, University of Florida; an M.S. in engineering science from the University of South Florida; and a B.S. in chemistry from the University of Nottingham, England. Dr. Brown has been at Winrock International since 1998, and is a Senior Scientist in the Ecosystems Services Unit. Prior to joining Winrock, she was a Professor in the Department of Forestry at the University of Illinois in Champaign-Urbana. Dr. Brown has more than 25 years of experience in planning, developing, implementing, and managing government and private-sector-funded projects focusing on understanding the role of forests in the global carbon cycle and their present and potential future role in climate change and mitigation—work that has resulted in more than 180 peer-reviewed publications.

DANIEL CAYAN

Scripps Institution of Oceanography / U.S. Geological Survey

Daniel Cayan is a Research Meteorologist at Scripps Institution of Oceanography (SIO), University of California, San Diego, and is also a researcher for the U.S. Geological Survey. His work is aimed at understanding climate variability and changes over the Pacific Ocean and North America. Specific interests concern impacts of climate changes on water resources and other sectors in California. Dr. Cayan heads the California Applications Program and the California Climate Change Center—climate research programs to improve climate information and forecasts for decision makers in the California region (for more information, see <http://meteora.ucsd.edu/cap/>). Since 1996, he has served as Director of the Scripps Climate Research Division. Dr. Cayan received a B.S. in meteorology and oceanography in 1971 from the University of Michigan, and a Ph.D. in oceanography in 1990 from the University of California, San Diego. He has worked for SIO since 1977 and the U.S. Geological Survey Water Resources Division since 1991.

STEVEN CLIFF

University of California, Davis

Steven Cliff is an Atmospheric Scientist in the Department of Applied Science at the University of California, Davis. He earned his B.S. and Ph.D. in chemistry at the University of California, San Diego. Dr. Cliff's research includes development and application of novel sampling and analytical techniques for atmospheric particulate matter. Dr. Cliff's research projects involve defining aerosols in air masses from Asia, the Middle East, and North America. These studies span both air quality and global climate disciplines. Recent work involves characterizing aerosols transported to the United States from across the Pacific Ocean, which may have implications for climate in California.

CHRISTOPHER CONROY

University of California, Berkeley

Christopher Conroy received his Ph.D. in biology from the University of Alaska, Fairbanks, and he worked at Stanford University as a postdoctoral researcher in Elizabeth Hadly's laboratory. In his current position as Staff Curator of the mammal and herpetology collections at the Museum of Vertebrate Zoology (MVZ) at the University of California, Berkeley, Dr. Conroy's

responsibilities include database management and overseeing specimen cataloging and loans. His current research interests include systematics of arvicoline rodents and phylogeographic history of rodents (particularly voles) in California. He is also interested in the use of molecular data to recover dates of phylogenetic events, cospeciation between rodents and their pathogens, and the history of natural history museums. Since 2003, he has been involved in the Grinnell Resurvey project at the MVZ, where his primary role is leading mammal fieldwork and curating the collections that come from the project.

MICHAEL DETTINGER

Scripps Institution of Oceanography / U.S. Geological Survey
 Michael Dettinger is a research hydrologist for the U.S. Geological Survey, Western Branch of Regional Research, and a research associate at Scripps Institution of Oceanography. Dr. Dettinger has monitored and researched water resources of the West for over 20 years, with emphases on regional surface- and groundwater systems, and on climatic influences on water resources. In 1996, he was honored with a Vice President's National Performance Review Award for physical-sciences leadership in Mojave Desert Ecosystems science-planning efforts. Dr. Dettinger was the program chair and fundraiser for the annual Pacific Climate (PACLIM) Workshops from 1998 to 2004, and is a member of the external Science Steering Group for the federal Global Water Cycle Program. He has degrees from the University of California, San Diego, and the Massachusetts Institute of Technology, and a Ph.D. in atmospheric sciences from the University of California, Los Angeles.

PHILIP DUFFY

Lawrence Livermore National Laboratory
 Philip Duffy is a research scientist at Lawrence Livermore National Laboratory and an Associate Adjunct Professor in the School of Natural Sciences at the University of California, Merced. Dr. Duffy is also Director of the University of California's Institute for Research on Climate Change and its Societal Impacts. His primary research interest is improving understanding of the societal impacts of climate change, such as its effect on water availability, air quality, and human health, particularly as they affect California. With this goal in mind he has worked toward improving the regional-scale fidelity of global climate models, and uses these models to understand how climate change will affect

our region. Dr. Duffy has a B.S. from Harvard in astrophysics, and a Ph.D. from Stanford in applied physics. He has published papers in astrophysics, atomic physics, and climate research.

BRIAN ELLIS

California Energy Commission

Brian Ellis is a Research Contract Manager with the Public Interest Energy Research (PIER) Program, PIER Environmental Area, of the California Energy Commission. Mr. Ellis concentrates on projects analyzing the ecological impacts of climate change and carbon sequestration. He received a B.S. in physics and a B.A. in nature and culture from the University of California, Davis.

GUIDO FRANCO

California Energy Commission

Guido Franco is a Technical Research Manager with the Public Interest Energy Research (PIER) Program, Climate Change Area, of the California Energy Commission. Mr. Franco is the principle author of the statewide inventory of greenhouse gas emissions released by the Energy Commission in 1997 and led the development of a long-term research plan on climate change. He was a principle author of this plan which PIER is implementing through the creation of the California Climate Change Center. Mr. Franco provides PIER's technical leadership for this Center. He prepared a technical paper on climate change impacts and adaptation options for California in support of the *2005 Integrated Energy Policy Report* and was lead technical manager and author of the climate science report prepared for California's Climate Action Team. Mr. Franco is a certified engineer in California and received his M.S. from the University of California, Berkeley.

ALEXANDER (SASHA) GERSHUNOV

Scripps Institution of Oceanography

Alexander (Sasha) Gershunov has broad interests in interrelated aspects of weather, climate, and society. His research interests include climate teleconnections and the connections between weather and climate, low-frequency and large-scale climatic controls on regional weather patterns, climatic forcing of weather extremes and weather extremes as determinants of climate, long-range prediction of weather statistics, variability and prediction of water resources, global climate model downscaling and statistical correction, regional modes of climate variability and their global interactions, model-Nature intercomparisons,

proxy climate reconstruction, climate and wildfire, and climate influence on society and human influence on climate. As a researcher, Mr. Gershunov studies interrelated aspects of Mother Nature, not merely isolated details of modeled reality. He enjoys working with friends and has strong regional and global research collaborations.

NICOLAS GRAHAM

Hydrologic Research Center/Scripps Institution of Oceanography

Nicholas Graham has dual appointments at the Hydrologic Research Center (HRC) and Scripps Institution of Oceanography (SIO). Dr. Graham joined SIO in 1987 and HRC in January 2000. He received his B.S., M.S., and Ph.D. from the University of California, Santa Barbara. His Ph.D. dissertation concerned large-scale patterns of ocean temperature variability in the Pacific and featured the design and verification of sophisticated physically based statistical models for El Niño prediction. As a forecaster and an air quality climatologist with North American Weather Consultants, Dr. Graham participated in many air quality tracer studies in the western United States and Canada. At SIO, his work has focused on air-sea interactions, El Niño prediction, and seasonal climate prediction. As part of this work, Dr. Graham directed the Climate Forecast Division of the International Research Institute for Climate Prediction and guided development of its climate forecasting capabilities. At HRC, Dr. Graham helps develop projects using seasonal climate forecast information in land-surface applications and water resource management.

ODELLE HADLEY

Scripps Institution of Oceanography

Odelle Hadley received her B.S. from The Evergreen State College in Olympia, Washington. During this time, Ms. Hadley was an intern for the Olympic Air Pollution Control Authority (OAPCA), where she maintained air quality stations and collected and archived data on aerosol and ozone concentrations in the region. After receiving her degree, Ms. Hadley worked two years for OAPCA as an Air Quality Specialist, where her duties were expanded to include inspections of pollution sources for compliance with clean air regulations. In 2002, she was accepted to Scripps Institution of Oceanography as a graduate student researcher. She recently finished her fourth year of graduate studies. Ms. Hadley's research interests include the long-range transport of aerosols and BC (black carbon or soot), as well as measurements of BC

concentrations in rain and snow and enhanced melt rate of snow due to enhanced BC concentrations.

ELIZABETH HADLY

Stanford University

Elizabeth Hadly is an Associate Professor in the Department of Biological Sciences and the Department of Geologic and Environmental Sciences at Stanford University. Dr. Hadly received her Ph.D. from the University of California, Berkeley. She researches how perturbations such as climatic change influence the evolution and ecology of Neogene vertebrates. She addresses problems in organismal biology from both evolutionary and ecological perspectives, primarily using extant mammals. One of the unique aspects of her overall approach is the focus on the decadal to millennial time scale—a scale that is little studied, yet is integral to understanding links between ecology and evolution. Professor Hadly uses a combined field and laboratory approach. Her field research involves excavation of Holocene paleontological sites and collection of modern specimens in western North America and Patagonia. Laboratory work includes morphometric and genetic analyses.

MICHAEL HANEMANN

University of California, Berkeley

Michael Hanemann is a Chancellor's Professor of Environmental Economics and Policy in the Department of Agricultural and Resource Economics and the Goldman School of Public Policy at the University of California (UC), Berkeley. He is also the Director of the California Climate Change Center at UC Berkeley. His major fields of interest are environmental economics and policy, water resource economics and policy, and climate change economic and policy; he has published extensively in these fields. Dr. Hanemann holds a B.A. in philosophy, politics, and economics from Oxford University, an M.S. in economics from the London School of Economics, and a Ph.D. in economics from Harvard University. He was awarded an honorary Ph.D. by the Swedish University of Agricultural Sciences

LEE HANNAH

Center for Applied Biodiversity Science at Conservation International

Lee Hannah is a leading authority on extinction risk from climate change. His work includes identifying species at risk from climate

change, and identifying extinction risk in the global biodiversity hotspots. Dr. Hannah began his climate change research while living in Cape Tomn (Cape Town), South Africa, where he and collaborator Guy Midgley of Kirstenbosch Gardens led a project to model climate change effects on the ranges of the protea family. This work led to a collaborative paper which examined extinction risk from climate change in six regions around the world; the paper appeared as the cover story of the January 2004 issue of *Nature*, and generated widespread press interest in extinction risk from climate change. Dr. Hannah is an Adjunct Professor at the Bren School of Environmental Science and Management at the University of California, Santa Barbara. He received a Ph.D. from the University of California, Los Angeles, an M.S. from the University of Hawaii, and a B.S. from the University of California, Berkeley.

RICHARD HOWITT

University of California, Davis

Richard Howitt is a Professor of Agricultural and Resource Economics and Department Chair at the University of California (UC), Davis. He has been a faculty member at UC Davis since 1975 and teaches courses in resource economics, economic theory, and operations research. Professor Howitt's current research interests cover three areas: (1) disaggregated economic modeling methods (to model the economic structure of farming and other economic uses of land and resources), (2) using market mechanisms to allocate water resources, and (3) empirical dynamic stochastic methods (which can be used to analyze the switch in investments and changes in institutions subject to dynamic stochastic inputs and irreversible costs or decisions). Current research applications include the optimal management of reservoirs given uncertain water supplies. Professor Howitt serves on advisory boards for the California Department of Water Resources and U.S. Academy of Sciences. Current research grants are from the U.S. Department of Agriculture Economic Research Service, California Water Resources Center, California Department of Agriculture, and California Energy Commission.

MARK JACOBSON

Stanford University

Mark Jacobson is an Associate Professor in the Department of Civil and Environmental Engineering at Stanford University, and Director and co-founder of the department's Atmosphere/Energy

Program. His research seeks to better understand, through numerical modeling, the feedbacks of aerosol particles and gases to weather and climate, and the effects of energy use on climate and air pollution. He has published two textbooks, *Fundamentals of Atmospheric Modeling* and *Atmospheric Pollution: History, Science, and Regulation*, as well as 70 peer-reviewed scientific journal articles. He has also developed computer algorithms used by hundreds of researchers. Dr. Jacobson received the 2005 American Meteorological Society Henry G. Houghton Award for "significant contributions to modeling aerosol chemistry and to understanding the role of soot and other carbon particles on climate." He earned a B.S. with distinction in civil engineering, a B.A. with distinction in economics, and an M.S. in environmental engineering from Stanford. He earned an M.S. and Ph.D. in atmospheric sciences from UCLA. See www.stanford.edu/group/efmh/jacobson.

JOHN KADYSZEWSKI

Winrock International

John Kadyszewski is the leader of Winrock International's Ecosystem Services group. He joined Winrock International in 1989 and provides leadership on the application of emerging science and technology to address energy and resource management issues. Mr. Kadyszewski led development and testing of peer-reviewed methods and procedures for measuring carbon storage in terrestrial systems and continues to direct efforts to apply advanced aerial monitoring tools to improve measurement and analysis of land management practices and associated environmental impacts. He has analyzed, developed, managed, and implemented a range of biomass energy projects, including most recently an analysis of the technical options and costs for conversion of forest and agricultural residues into liquid transportation fuels. He has carried out projects in the United States and more than 20 countries in Africa, Latin America, Asia, and Europe. Prior to joining Winrock International, he worked for the Tennessee Valley Authority and at the Solar Energy Research Institute. He has an engineering degree from Princeton University.

MICHAEL KLEEMAN

University of California, Davis

Michael Kleeman received his B.S. in mechanical engineering from the University of Waterloo and his M.S. and Ph.D. in environmental engineering science from the California Institute of

Technology. Dr. Kleeman is currently an Associate Professor in the Department of Civil and Environmental Engineering at the University of California, Davis. His research interests focus on the study of urban and regional air quality problems, with an emphasis on the size and composition of atmospheric particles and gas-to-particle conversion processes. Dr. Kleeman is conducting a series of measurements and model calculations to determine which sources currently contribute to various aspects of the particulate air pollution problem in California's San Joaquin Valley. He is also leading several efforts to study how future air quality in the San Joaquin Valley will be affected by changes at the local, regional, and global scale.

NOAH KNOWLES

U.S. Geological Survey

Noah Knowles received a Ph.D. from Scripps Institution of Oceanography (SIO), where his dissertation topic was "Modeling the Hydroclimate of the San Francisco Bay-Delta Estuary and Watershed." Dr. Knowles has since served as a postdoctoral researcher at SIO and currently as a National Research Council Research Associate with the U.S. Geological Survey (USGS) in Menlo Park, California. His research has included historical trends in precipitation form in the western United States, and the influence of projected climate change in California, including changes in snowpack, runoff timing, and Bay-Delta water quality. Dr. Knowles' research topics include continued hydrologic and estuarine model development, the role of vegetation in shaping the hydrologic response to climate change, and changes in estuarine water quality and spatial extent due to sea level rise.

MARTHA KREBS

California Energy Commission

Martha Krebs is Deputy Director of the Energy Research and Development Division for the California Energy Commission. The Division is responsible for the Public Interest Energy Research (PIER) Program, which conducts research that seeks to improve the quality of life for California citizens by developing environmentally sound, reliable, and affordable electricity and natural gas services and products. Before coming to the Energy Commission, Dr. Krebs was President of Science Strategies, an analysis and consulting firm that works with public and private organizations to identify critical issues and opportunities in science and technology. In 2001, she was the founding Director

of the California NanoSystems Institute (CNSI), at the University of California (UC), Los Angeles, and UC Santa Barbara. Earlier, Dr. Krebs was a Senior Fellow at the Institute for Defense Analysis, where she led studies in research and development management, planning, and budgeting. From 1993–2000, Dr. Krebs served as Assistant Secretary and Director of the Office of Science at the Department of Energy (DOE), and was responsible for the \$3.5 billion basic research program that underlay DOE's energy, environmental, and national security missions. From 1983–1993, she served as an Associate Director for Planning and Development at the DOE's Lawrence Berkeley National Laboratory, where she was responsible for strategic planning for research and facilities, Laboratory technology transfer, and science education and outreach. From 1977–1983, Dr. Krebs served on the House Committee on Science, first as a Professional Staff Member and then as Subcommittee Staff Director, responsible for authorizing DOE non-nuclear energy technologies and energy science programs. She received her B.S. and Ph.D. in physics from the Catholic University of America.

AMY LUERS

Union of Concerned Scientists

Amy Lynd Luers is an environmental scientist in the Global Environmental Program at the Union of Concerned Scientists (UCS). She leads UCS's California climate change science program aimed at strengthening support for strong state and regional climate policies. Dr. Luers was a member of the scientific coordinating committee for the 2006 climate scenarios research prepared as part of the California Climate Action Team's process. Her research and publications have focused on assessing the vulnerability of terrestrial and coastal systems to global environmental changes in California and Latin America. She holds a Ph.D. in environmental science, an M.A. in international policy studies from Stanford University, and a B.S. in environmental resources engineering from Humboldt State University.

JAY LUND

University of California, Davis

Jay Lund is a Professor of Civil and Environmental Engineering at the University of California, Davis. He specializes in the integrated management of large-scale water and environmental systems. His modeling activities have included economic engineering optimization modeling of California's extensive inter-tied system,

the Columbia River system, the Missouri River system, and other smaller systems—as well as more theoretical and methodological studies of integrated systems, including climate change, water marketing, water conservation, and reservoir system operations. He was on the Advisory Committee for the California Water Plan Updates of 1998 and 2005 and is a past editor of the *Journal of Water Resources Planning and Management*. For more information, visit <http://cee.engr.ucdavis.edu/faculty/lund/>.

CONSTANCE MILLAR

USDA Forest Service

Constance Millar is a Research Scientist with the Sierra Nevada Research Center, Pacific Southwest Research Station, USDA Forest Service, based in Albany and Lee Vining, California. A population and evolutionary forest geneticist by training, she earned a Ph.D. from the University of California, Berkeley. Dr. Millar currently studies the response of subalpine forests in the Sierra Nevada and Great Basin to historic and current climate change. She was an instrumental leader of the Sierra Nevada Ecosystem Project, and subsequently led several science review efforts for the U.S. Forest Service Sierra Nevada National Forest planning process. In 1992 she was nominated as a Pew Scholar for Conservation and the Environment. Dr. Millar is a leading organizer of CIRMOUNT (Consortium for Integrated Climate Research in Western Mountains), an interdisciplinary science initiative dedicated to understanding climate, ecosystem response to climate, and the effects of climate on natural resources and resource management in the mountains of western North America.

FRANK MITLOEHNER

University of California, Davis

Frank Mitloehner, Ph.D., began responsibilities as an Air Quality Cooperative Extension Specialist in the Department of Animal Science at the University of California (UC), Davis, in January 2002. His current research activities are in the areas of air emission estimates from dairies and other agricultural sources and emission mitigation (with a focus on volatile organic compounds, ammonia, particulate matter, and greenhouse gases). His extension efforts are largely related to teaching farmers and dairymen air quality—related information and assisting them in air quality compliance issues. Furthermore, he educates the agencies involved in regulating agricultural sources to better understand operational details and processes.

Dr. Mitloehner also serves as Director for the Agricultural Air Quality Center at UC Davis, coordinating the efforts of more than 30 professors with an interest in agricultural air quality.

SUSANNE MOSER

National Center for Atmospheric Research (NCAR) Institute for the Study of Society and Environment

Susanne Moser is a Research Scientist at the National Center for Atmospheric Research (NCAR) Institute for the Study of Society and Environment in Boulder, Colorado. A geographer by training (Ph.D. from Clark University), her work over the past 15 years has focused on interdisciplinary challenges such as the impacts of climate change and sea level rise on coastal areas, community and state responses to such global change hazards, the interaction between science and policy/practice, and the communication of climate change risks in support of societal responses to climate change. Dr. Moser was a postdoctoral fellow at Harvard's John F. Kennedy School of Government, and before coming to NCAR, worked for the Heinz Center in Washington, D.C., and as staff scientist for climate change for the Union of Concerned Scientists in Cambridge, Massachusetts. In 2005 she was selected as a Fellow of the Aldo Leopold Leadership and the University Corporation for Atmospheric Research (UCAR) Leadership programs.

NEHZAT MOTALLEBI

California Air Resources Board

Nehzat Motallebi is a staff air pollution specialist in the Research Division of the California Air Resources Board (ARB). Her primary responsibility at ARB includes managing research projects in the field of particulate matter monitoring, data analysis, and regional air quality modeling. She is also managing research projects on the global radiative effect of particulate black carbon, improving estimates of carbon dioxide emissions from the combustion of fossil fuels in California, and the impact of climate change on meteorology and regional air quality in California. Dr. Motallebi has a Ph.D. in atmospheric science from the University of California, Davis.

LAWRENCE MYER

California Energy Commission

Lawrence Myer is a Staff Scientist at Lawrence Berkeley National Laboratory's Earth Sciences Division, where he has conducted

research in geophysics and geomechanics since 1981. Dr. Myer has been leading research activities in geologic sequestration since 1999. He is on assignment to the California Energy Commission, Public Interest Energy Research Program, as Technical Director of the West Coast Regional Carbon Sequestration Partnership. The Partnership is evaluating carbon dioxide capture, transport, and sequestration technologies, involving both terrestrial and geologic options, for the West Coast of the United States and Canada. Dr. Myer has a Ph.D. in geological engineering from the University of California, Berkeley.

WILLIAM REISEN

University of California, Davis

William Reisen is a Research Entomologist in the Center for Vectorborne Diseases and an Adjunct Professor in the Department of Pathology, Microbiology and Immunology in the School of Veterinary Medicine at the University of California, Davis. His research focuses on the ecology, epidemiology, and control of mosquito-borne viruses—recently emphasizing West Nile virus. In collaboration with the Climate Division of Scripps Institution of Oceanography, he and his research team have been assembling a large historical and real-time data set measuring changes in mosquito abundance and virus activity in California to evaluate the impact of climate variation at varying scales. The ultimate goal is to use climate forecasts to estimate the risk of arbovirus activity. He currently is Chair of the Vector Control Advisory Committee of the California Department of Health Services and of the Disease Control Committee of the Mosquito and Vector Control Association of California, and has been an editor with the *Journal of Medical Entomology* for 17 years.

DANIEL ROSENFELD

The Hebrew University of Jerusalem

Daniel Rosenfeld is a Professor of Meteorology at the Hebrew University of Jerusalem, Israel. Dr. Rosenfeld's research has focused on the impacts of cloud-aerosol interactions on precipitation, water resources, and climate change. He has conducted and evaluated cloud-seeding experiments in Israel, the United States, and Southeast Asia. He has developed new methodologies to assess cloud microstructure, precipitation-forming processes, and rainfall measurements by remote sensing from space; validated them; and applied them for documenting the impacts of smoke and air pollution, as well as of cloud

seeding, on cloud properties and precipitation. These studies have shown that air pollution from densely populated areas can delay precipitation-forming processes in clouds, which leads to a net decrease of precipitation from winter clouds. Dr. Rosenfeld has documented his research in nearly 100 refereed scientific publications and has received numerous awards for his achievements in satellite remote sensing, climate change, and weather modification. He is a Fellow of the American Meteorological Society. Dr. Rosenfeld received his M.S. and Ph.D. degrees in atmospheric sciences, and a B.S. in geology at the Hebrew University of Jerusalem.

WILLIAM SALAS

Applied Geosolutions, LLC

William Salas is the President and Chief Scientist of Applied Geosolutions, LLC (AGS). AGS promotes, supports, and provides geo-spatial technologies, biogeochemical models, and integrated spatial information services for greenhouse gas (GHG) emission inventories, GHG mitigation studies, and water and air quality impact studies of agricultural and forestry management. Before forming AGS, Dr. Salas worked at NASA's Jet Propulsion Laboratory and at the Complex Systems Research Center at the University of New Hampshire (UNH). Dr. Salas's expertise includes use of remote sensing, land use and soil biogeochemical modeling, and GIS tools for environmental applications, focusing on urban sprawl and the impacts of land use on water and air quality. Current research and application development focuses on building tools for GHG emission inventories, developing process models for estimating air emissions from animal feeding operations, and developing web-based decision support systems for agricultural and rangeland management through the integration of geographic information systems, remote sensing, and the Denitrification-Decomposition biogeochemical model. Dr. Salas received his B.S. in mathematics and physics at University of Vermont and his M.S. and Ph.D. in natural resources at UNH.

STEVE SHAFFER

California Department of Food and Agriculture

Steve Shaffer is Director of the Office of Agriculture and Environmental Stewardship for the California Department of Food and Agriculture (CDFA), a position he has held since November 2000. The office comprises an outstanding group of scientists who address environmental issues related to agriculture using a

multidisciplinary approach. In his capacity as Director, he represents CDFA on a number of environmental, energy, and natural resource management planning, implementation, and monitoring activities as they relate to agriculture. Mr. Shaffer served on the Governor's California Performance Review, a comprehensive review of state government "to make it work better and cost less." He is currently serving on the board of the California Biomass Collaborative, on the Interagency Bioenergy Workgroup, and on the Climate Action Team. He has been working to support the production and use of biofuels since 1981. Mr. Shaffer graduated from the University of California, Santa Barbara, with a degree in biochemistry/molecular biology. He recently celebrated 31 years at CDFA, serving the public, agriculture, and the environment.

JOHAN SIX

University of California, Davis

Johan Six is an Assistant Professor in Agroecology in the Department of Plant Sciences at the University of California (UC), Davis. Dr. Six received his Ph.D. in soil science from Colorado State University. His doctoral research was conducted in the Natural Resource Ecology Laboratory (NREL) under the supervision of Dr. E. T. Elliott and Dr. K. Paustian. His research focused on the mechanisms underlying greenhouse gas mitigation by no-tillage practices. Dr. Six remained at NREL as a Research Scientist from 1998 until 2002. He led and was involved in many projects investigating the effect of land use change and management on greenhouse gas fluxes in agricultural, grassland, and forest ecosystems. Since arriving at UC Davis in 2002, Dr. Six has further developed this line of research and expanded it to water-quality issues—in particular, investigating the effects of ecosystem management on pollutant (i.e., nitrogen, *E. coli*, and carbon) loads in drainage canals.

LISA CIRBUS SLOAN

University of California, Santa Cruz

Lisa Cirbus Sloan is a Professor of Earth Sciences and the Director of the Climate Change and Impacts Laboratory at the University of California (UC), Santa Cruz. Dr. Sloan received her Ph.D. from Pennsylvania State University and did her postdoctoral work at the University of Michigan. Dr. Sloan joined the faculty of UC Santa Cruz in 1995. She has been the National Secretary of the American Geophysical Union's Ocean Sciences Section, a

Fellow of the David and Lucile Packard Foundation, Editor-in-Chief of the international journals *Global and Planetary Change* and *Paleoceanography*, and has co-chaired the National Center for Atmospheric Research's Paleoclimate Working Group. Dr. Sloan's research is concentrated in two broad areas: investigating and modeling the extreme warm climates in Earth's past, and investigating and modeling future climate change at regional scales and investigating the possible impacts of future climate change on human and natural systems. She has authored or coauthored more than 60 peer-reviewed articles and book chapters. See www.es.ucsc.edu/~lcsloan/.

JAMES THORNE

University of California, Davis

James Thorne is a landscape ecologist at the Department of Environmental Science and Policy at the University of California, Davis, with three areas of research: biotic response to climate change, patterns of species distributions in space and time, and using urban growth scenarios to assess impacts on natural environments. Dr. Thorne has been working with the Public Interest Energy Research Program on two projects: to model plant species range distributions in California under current and future conditions; and to reconstruct historical surveys of vegetation in the Sierra Nevada, which permit the assessment of changes in dominant landcover over the past 70 years. The historical surveys (the Wieslander data) cover the central and northern Sierra, as well as large portions of the Coast Ranges. Dr. Thorne's group has digitized about 30,000 square kilometers of this region. Dr. Thorne earned a Ph.D. in ecology from the University of California, Davis, an M.A. in geography from the University of California, Santa Barbara, and a B.A. in environmental studies from the University of California, Santa Cruz.

SEBASTIAN VICUÑA

University of California, Berkeley

Sebastian Vicuña is a Ph.D. student working with Professor John Dracup in the Department of Civil and Environmental Engineering at the University of California (UC), Berkeley. His research is focused on the impact of climate change on California hydrology and water resources. Mr. Vicuña has studied the effects of climate change on high-elevation hydropower generation, water use in the agriculture sector, and the conjunctive use of surface water and ground water as a climate change strategy in

California. His B.S. degree is in environmental engineering from the Catholic University of Santiago, Chile, and at UC Berkeley he earned two M.S. degrees—one in public policy from the Goldman School of Public Policy and one in civil and environmental engineering. Before coming to the United States, he worked on a wide range of environment-related projects in Chile.

EDWARD VINE

California Institute for Energy and Environment

Edward Vine is Program Manager of the Environmental Program at the California Institute for Energy and Environment (CIEE). He provides technical assistance to the PIER Environmental Area (PIER-EA) Program at the California Energy Commission and is Program Administrator for two PIER-EA programs: the Environmental Exploratory Grant Program and the Climate Change Grant Program. Dr. Vine is also a Staff Scientist at Lawrence Berkeley National Laboratory and has been involved in the evaluation of energy efficiency programs and technology performance measurement for over 26 years. Dr. Vine is widely published on the evaluation of energy efficiency programs and energy policy and is a member of the American Evaluation Association, the Board and Planning Committee of the International Energy Program Evaluation Conference, the Association of Energy Services Professionals, and the California Demand-Side Management Measurement Advisory Committee. He is an Affiliated Faculty Member of the Energy and Resources Group at the University of California, Berkeley.

ANTHONY WESTERLING

University of California, Merced

Anthony Westerling is an Assistant Professor in the School of Engineering and the School of Social Sciences, Humanities and

Arts at the University of California (UC), Merced. He is a principal investigator in the California Applications Program and the California Climate Change Center at Scripps Institution of Oceanography (SIO). Before his appointment at UC Merced, he spent six years in the Climate Research Division at SIO as a Post-graduate Researcher and Assistant Project Scientist. His research interests include applied climatology and seasonal forecasting for wildfire activity and for energy demand in western North America.

DOUGLAS WICKIZER

California Department of Forestry and Fire Protection

Douglas Wickizer is Department Chief for Environmental Protection, Regulation, and Forest Product Utilization for the California Department of Forestry and Fire Protection (CDF), where he has worked since 1973 in a variety of field and management positions. The Department's interests and efforts in biomass utilization and global climate change are a portion of his work. Mr. Wickizer has contributed to the success of numerous projects, including major revisions of the Forest Practice Rules, completion of the initial Soil Erosion Study, establishment of the original Board Monitoring Study Group, and design and preparation of the 1996 California Fire Plan. He contributed to the 2004 FRAP report and to the current Forestry Protocols for the California Climate Action Registry. Most recently, Mr. Wickizer was appointed to the Board of Directors for the California Biomass Collaborative and is a member of the California Bio-Energy Interagency Working Group. He continues to represent both the Department and the Board of Forestry and Fire Protection in climate change activities and initiatives. Mr. Wickizer earned a B.S. in Forest Land Management from Northern Arizona University.

1. **Shifting Ranges: Northern Expansion and Predation Escape in the Barnacle *Tetraclita rubescens***
D. Swezey (UC Santa Barbara), S. Gaines (UC Santa Barbara), and E. Sanford (UC Davis)
2. **Conservation of Pacific Salmon in a Changing Climate**
Peter Miller (UC Berkeley)
3. **Climate Change and the Fate of California's Endemic Flora**
S. Loarie (Stanford University), B. Carter (Cal Poly San Luis Obispo), K. Hayhoe (Texas Tech University), C. Knight (Cal Poly San Luis Obispo), and D. Ackerly (UC Berkeley)
4. **Adapting to Climate Change through Smart Growth and LEED-ND**
C. Pyke (U.S. EPA), J. Scharfenberg (ICF International), S. Shapiro (ICF International), R. Freed (ICF International), W. Schroeer (ICF International), and E. Allen (Criterion Planners Inc.)
5. **The Cost of Uncertainty on CO₂ Emissions Regulations**
Dalia Patiño-Echeverri (Carnegie Mellon University)
6. **Greenhouse Gas Emission Consequences of a Transition to Low-quality and Synthetic Petroleum Resources**
Adam R. Brandt and Alexander E. Farrell (UC Berkeley)
7. **Least Cost Distributed Energy Resources Carbon Mitigation**
Ryan Firestone and Chris Marnay (LBNL)
8. **Technology-Policy Driven Decarbonization Scenarios for California**
Frank Ling and Dan Kammen (UC Berkeley)
9. **What Is the Magnitude of Greenhouse Gas Emissions from Urban Turfgrass Landcover?**
D.E. Pataki, N. Bijoor, C. Czimczik, and S.E. Trumbore (UC Irvine)
10. **Potential for Alternatives in Farm Management to Reduce Soil Greenhouse Gas Emissions**
C. Kallenbach, W. Horwath, Z. Kabir, D. Rolston, and J. Mitchell (UC Davis)

11. **Assessing Seasonal Greenhouse Gas Emissions and Belowground C and N Processes under Different Fire Frequencies in Soils of Sierra Nevada Chaparral Shrublands**
U. Norton, W.R. Horwath, J.B. Norton, and T. D. Doane (UC Davis)
12. **Assessing Impacts of Rangeland Management and Afforestation of Rangelands on Net Greenhouse Gas Emissions: A Scoping Study for Shasta County**
W. Salas (Applied Geosolutions, LLC), C. Li (University of New Hampshire), and P. Green (Applied Geosolutions, LLC)
13. **Field Scale Greenhouse Gas Emissions in a Furrow-irrigated Field under Standard and Minimum Tillage**
D.E. Rolston, J.W. Hopmans, J. Six, C. van Kessel, K.T. Paw U, R.E. Plant, J. Lee, J. Kochendorfer, A.J. Ideris, K.J. Evatt, A.A. Matista, D. Louie, J.L. MacIntyre, and A.P. King (UC Davis)
14. **Detection of Climate Change in California and Attribution of Causes**
C. Bonfils (UC Merced/LLNL), P.B. Duffy (LLNL), B.D. Santer (LLNL), D.B. Lobell (LLNL), and T.M.L. Wigley (NCAR)
15. **California Temperature-trends in Cooling-coastal and Warming-inland Air Basins**
B. Lebassi (Santa Clara University), J. E. González (Santa Clara University), D. Fabris (Santa Clara University), E. Maurer (Santa Clara University), R. Bornstein (San Jose State University), and N. Miller (LBNL)
16. **Development of Climate Monitoring Indices for California**
Laura M. Edwards and Kelly T. Redmond (Desert Research Institute)
17. **Paleoclimate Teleconnections, Fire, and Erosion During Holocene Abrupt Climate Change Events, Northern Sierra Nevada, California**
Steve Wathen (UC Davis)
18. **Sierra Nevada Speleothems (stalagmites and stalagmites): Potential as High-resolution Archives of Changes in Atmospheric Circulation over California**
Jessica Oster (UC Davis)

19. Changes in California Irrigation Since 1889 and Its Impact on Temperatures

David Lobell (LLNL) and Celine Bonfils (UC Merced/ LLNL)

20. Climate, Extreme Heat, and Energy Demand

N.L. Miller (LBNL), K. Hayhoe (Texas Tech University), J. Jin (LBNL), and M. Auffhammer (UC Berkeley)

21. Downscaling U.S. Daily Precipitation and Temperature Fields with Constructed Analogues

H.G. Hidalgo, M.D. Dettinger, and D.R. Cayan (Scripps Institute of Oceanography)

22. Validation of Regional Climate Model Output Using Bayesian Statistical Methods

M.A. Snyder, B. Sansó, and L.C. Sloan (UC Santa Cruz)

23. Opportunities for Low-Cost CO₂ Mitigation in Electricity, Oil, and Cement Production

G.H. Rau (UC Santa Cruz/LLNL), K.G. Knauss (LLNL), K. Caldeira (Carnegie Institution), and J. Friedmann (LLNL)

24. Modeling the Effects of Gas-Phase CO₂ Intrusion on Soil Biogeochemistry

Andrew Altevogt (Princeton University)

25. Future Climate Alters VOC Reactivity and Potential Ozone Control Strategies in Central California

A.L. Steiner (UC Berkeley), S. Tonse (LBNL), R. Cohen (UC Berkeley), A.H. Goldstein (UC Berkeley), and R.A. Harley (UC Berkeley)

26. Progress on Incorporating Climate Change into Management of California's Water Resources

Jamie Anderson and Francis Chung (California Department of Water Resources)

27. Monitoring Monthly Hydrologic Data to Detect Climate Change in California

Maurice Roos and Michael L. Anderson (California Department of Water Resources)

28. Climate Change and the Colorado River Basin: Implications of the FAR Scenarios for Hydrology and Water Resources

Niklas Christensen and Dennis P. Lettenmaier (University of Washington)

29. Observed Changes in Spring Snowpack in California and the Role of Global Warming

Philip Mote (University of Washington)

30. Detectability of Trends Towards Earlier Streamflow in the Sierra Nevada

E.P. Maurer (Santa Clara University), I.T. Stewart (Santa Clara University), C. Bonfils (UC Merced/LLNL), and P.D. Duffy (LLNL)

31. Climate Change and the Probability of Persistent Drought

I. Ferguson (UC Berkeley/LLNL), P. Duffy (LLNL), J. Dracup (UC Berkeley), X. Liang (University of Pittsburgh), and D. Bader (LLNL)

32. Adaptability of California's Hydropower System to Climate Warming

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notes



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