Testimony of Dr. Peter H. Gleick[1]

For the Environmental Protection Agency Hearing on

The California Air Resources Board (CARB) Request for a Waiver of Preemption

Docket ID No. EPA-HQ-OAR-2006-0173

May 30, 2007

Critical Impacts of Climate Change to California Water Resources and Coastal Systems

I would like to thank the EPA and CARB for inviting my testimony today.

Let me begin by offering my qualifications.

I am President and co-founder of the Pacific Institute in Oakland, California. The Institute is an independent research and policy group addressing issues related to water, climate, and environmental policy and management.

I am an elected member of the United States National Academy of Sciences and an elected member of the International Water Academy in Oslo, Norway.

I have a B.S. in Engineering and Applied Sciences from Yale University, and an M.S. and Ph.D. in Energy and Resources from the University of California, Berkeley.

I am a MacArthur Foundation Fellow.

Reviewing my files, I see that I have testified before State and Federal legislative committees on the subject of climate change and water resources at least 15 times since 1987.

[1] Dr. Gleick is President of the Pacific Institute, Oakland, California. He is a scientist working on issues of climate and water, a member of the U.S. National Academy of Sciences, a MacArthur Fellow, and has published many peer-reviewed papers on water and climate issues.

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At the separate request of both the Intergovernmental Panel on Climate Change in Geneva, and the U.S. government, I am a formal reviewer of the technical papers on water and the synthesis reports of the IPCC Fourth Assessment.

My full CV is attached at the end of this testimony for the record.

Let me make this short and concise:

Summary

California's Legislature recognized, and the rulemaking record supports, extraordinary and compelling conditions in California that make us especially vulnerable to climatic changes from greenhouse gas emissions. In particular, California's coastal resources are especially threatened due to rising sea-level and changes in storm patterns; and our water resources are fundamentally connected to climatic conditions. Moreover, unlike other states, California is particularly vulnerable in its Bay-Delta area to saltwater intrusion from sea-level rise, levee collapse, and flooding, any of which would severely affect California's fragile but vital water-supply system. The predicted dramatic decrease in winter snowpack from rising temperatures is expected to worsen these impacts by reducing spring and summer snowmelt runoff critical for urban and agricultural uses. Thus California's circumstances are no less extraordinary and compelling than those it faced when Congress first recognized and provided for California's separate motor vehicle emission control program. As noted consistently in EPA decisions, CARB has continually demonstrated the existence of compelling and extraordinary conditions justifying the need for its own motor vehicle pollution control program.[2]

Overview of Impacts

Over 1,000 research papers have already been published on impacts of climate change on U.S. water resources, with a substantial focus on California (see the online bibliography at http://www.pacinst.org/CCBib.html.

California needs greenhouse gas standards in order to meet compelling and extraordinary conditions. In particular, the state must begin to mitigate and adapt to serious impacts to the **state's water systems** from rising temperature and changing precipitation patterns, as well as serious impacts to **coastal resources** from sea-level rise.

The National Assessment water sector report concluded that the evidence that humans are already changing the water cycle of the United States, and California, is compelling.[3]

Our existing water-related challenges are extraordinary; the expected impacts of climate change will vastly increase stresses on our water systems.

Complex impacts on every sector of society, including our water resources, agricultural productivity, and coasts are now unavoidable.

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[2] See, for example, Environmental Protection Agency decision [AMS-FRL-6414-3], "California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption--Notice of Waiver Decision and Within the Scope Determinations" http://www.epa.gov/fedrgstr/EPA-AIR/1999/August/Day-05/a20200.htm

[3] U.S. National Assessment. 2000. Water: The Potential Consequences of Climate Variability and Change. US Global Change Research Program. Washington D.C.

California's water resources are extraordinarily vulnerable for two reasons: we are uniquely dependent upon the size and dynamics of the Sierra Nevada snowpack for our water; and the risks of floods and droughts in the state are sensitive to changes in climatic conditions that alter storm formation, direction, and intensity in the Pacific Ocean off our coasts. California's snowpack will radically diminish this century. See Figures 1 and 2.

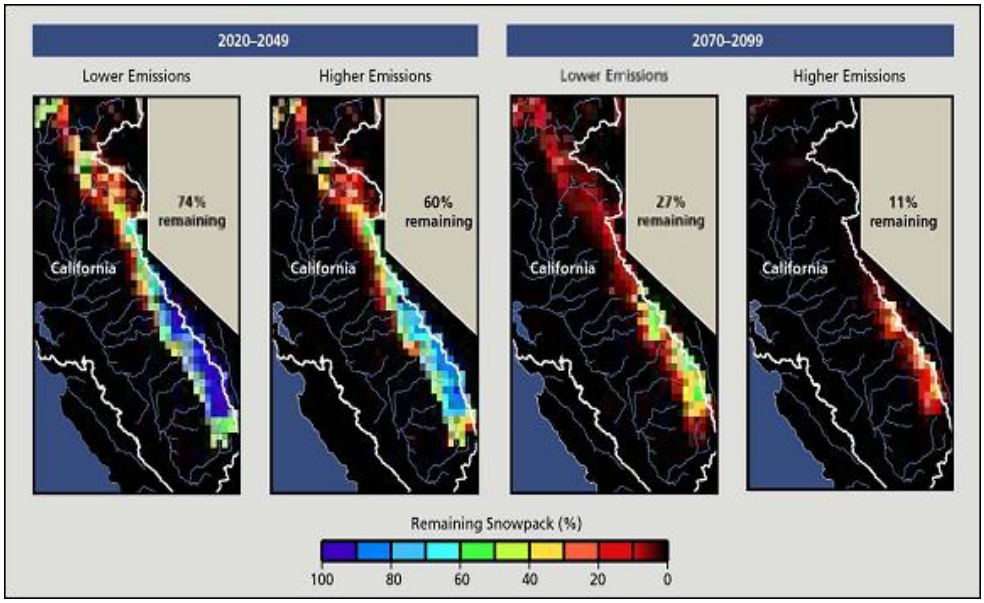
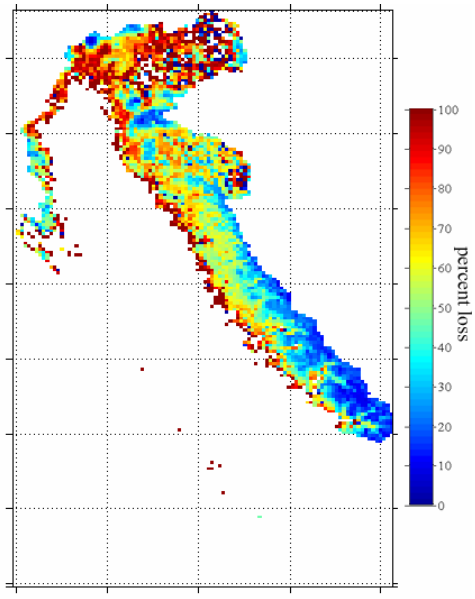


Figure 1 and 2: Knowles and Cayan 2004. Various representations of the dramatic loss of snowpack during the 21st century that will result from warming temperatures.



- There will be very important effects on water availability. [4]
    - Significant changes in the timing of runoff from the Sierra Nevada (see Figure 3);
    - Less snow, more rain, more late winter and early spring runoff;
    - Less late spring and early summer runoff;
    - Less summer soil moisture (more need for irrigation water)

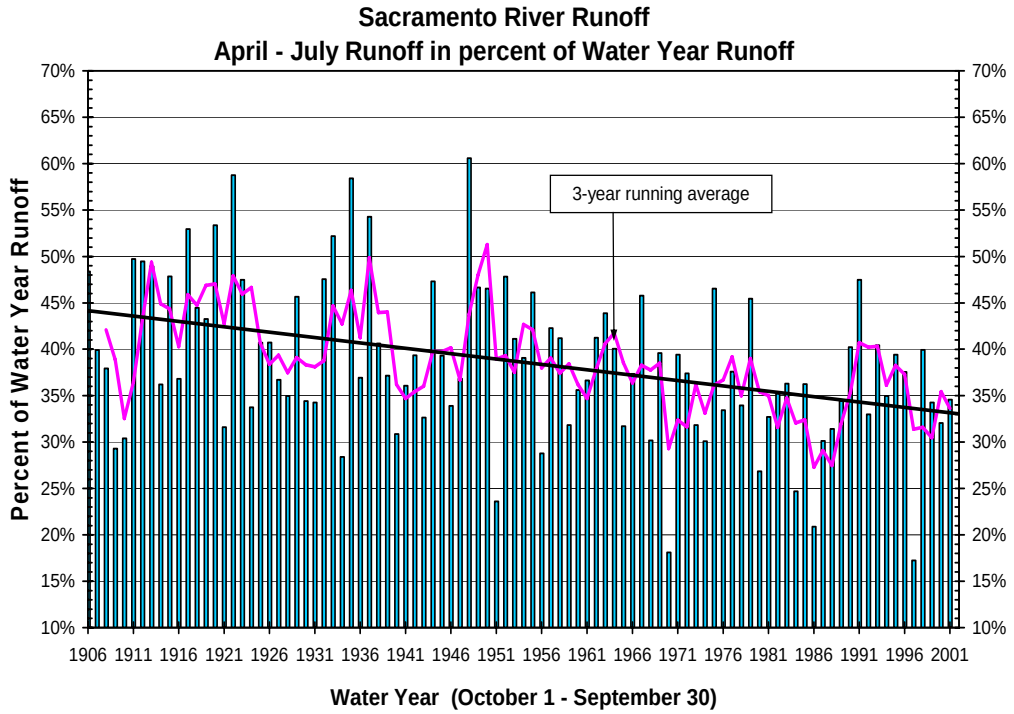


Figure 3. Evidence that spring runoff is already declining due to warming (Source: California Department of Water Resources, database, 2004).

- The risks of flooding may be as great as or greater than the risk of droughts, but evidence suggests we may see increases in the risks of both.

- Water quality will also be affected: salt water may penetrate farther into the Sacramento/San Joaquin Delta to where the pumps for our water supplies take fresh water for Bay Area and Southern California.

- The Colorado River will be directly affected with consequences for southern California cities and farms.

[4] The scientific basis for these findings is summarized in Our Changing Climate: Assessing the Risks to California: A Summary Report from the California Climate Change Center. California Energy Commission, July 2006 CEC-500-2006-077. See also, Michael Kiparsky and Peter Gleick, 2005. Climate Change and California Water Resources: A Survey and Summary of the Literature (Second Edition). CEC-500-2004-073-ED2, Revised Edition: August 2005

Similarly, sea-level rise will have widespread consequences for California's coasts:[5]

- Sea-level rise will affect hundreds of billions of dollars of economic development along California's coast, and threaten the destruction of the limited remaining natural coastal and bay wetlands.

- Sea-level rise from climate change will result in higher baseline sea levels interacting with tides, winter storms, and other episodic events. See Figure 4. Extreme high water levels will occur with increasing frequency (i.e., with shorter return period) as a result of mean sea level rise.

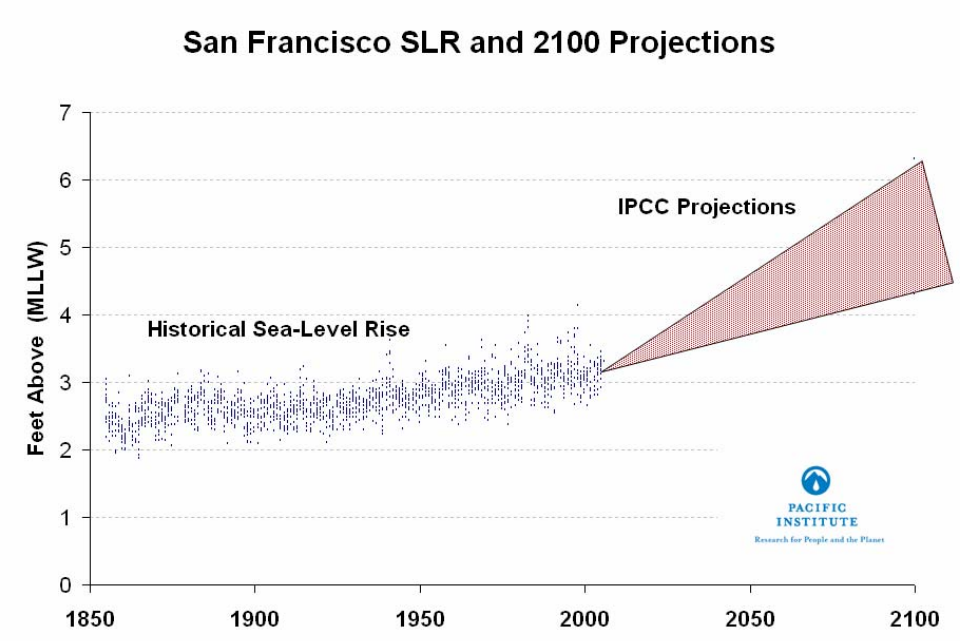
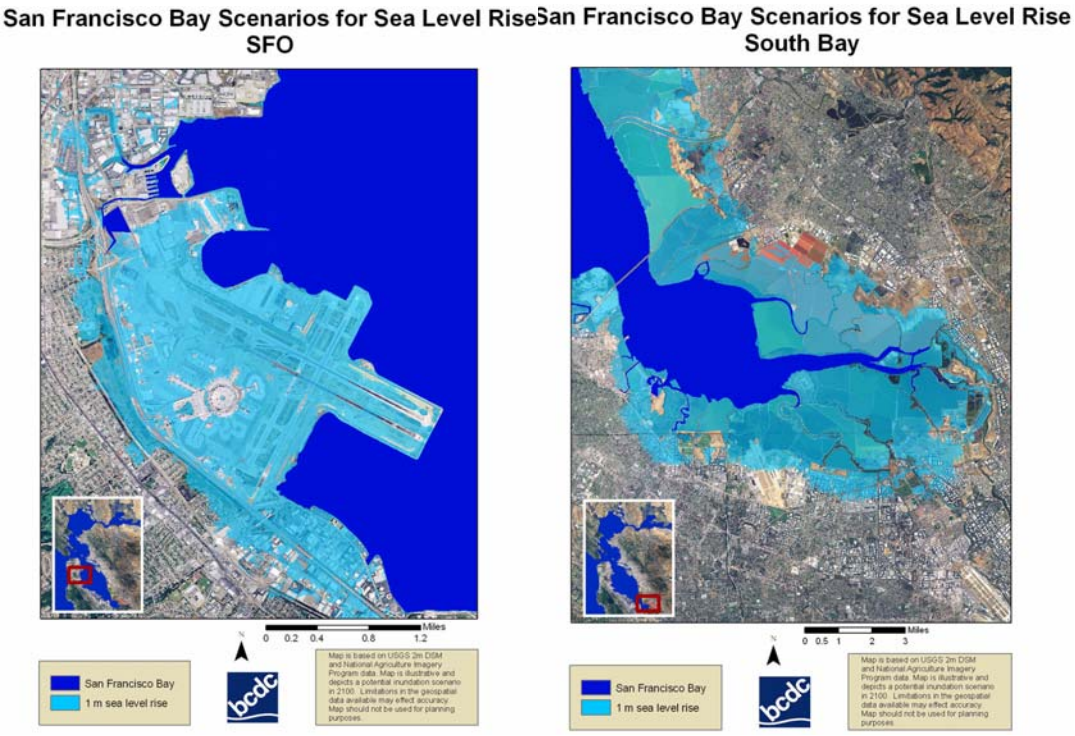


Figure 4. Historical sea-level rise measured at San Francisco shows an increase of 9 inches in 150 years. This rate is projected to accelerate substantially in coming decades. The range shown here comes from the latest Intergovernmental Panel on Climate Change report, www.ipcc.ch.

- Examples of regions with extreme vulnerability include major infrastructure in San Francisco Bay. Figures 5 and 6 shows examples of areas potentially destroyed by expected sea-level rise.

- There is an increased risk of contamination of freshwater coastal aquifers due to rising sea level.

[5] See, for example: Dan Cayan, Peter Bromirski, Katharine Hayhoe, Mary Tyree, Mike Dettinger, Reinhard Flick. "Projecting Future Sea Level." California Energy Commission. CEC-500-2005-202-SF, Sacramento, California.



Figures 5 and 6: Flood risks associated with a one-meter sea-level rise in San Francisco Bay. Source: Bay Conservation and Development Commission, San Francisco.

CV for Dr. PETER HENRY GLEICK

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EDUCATION

Doctorate (PhD)	University of California, Berkeley, Energy and Resources, 1986.
Master of Science (MS)	University of California, Berkeley, Energy and Resources, 1980.
Bachelor of Science (BS)	Yale University, in Engineering and Applied Science, 1978. Cum laude, with distinction.

EMPLOYMENT and RESEARCH POSITIONS

President and Co-Founder, 1987 to Present
Pacific Institute for Studies in Development, Environment, and Security.

Research Associate, 1983 to 1986.
Energy and Resources Group, University of California, Berkeley,

Deputy Assistant to the Governor of California. 1980-1982.
Energy and Environment Office of the Governor of California.

HONORS, AWARDS, FELLOWSHIPS

- Elected to United States National Academy of Sciences: April 2006.
- Named AAAS Fellow (Atmospheric and Hydrospheric Sciences): October 2005 (American Association for the Advancement of Science)
- Elected member of AAAS Atmospheric and Hydrospheric Sciences Section: February 2007-2011.
- Named IWRA Fellow: October 2005 (International Water Resources Association)
- Appointed United Nations-Sigma Xi Scientific Expert Group on Climate Change and Sustainable Development. November 2004
- Named MacArthur Fellow. October 2003
- Elected to Phi Beta Delta: Honor Society for scholarly achievement in international education. April 2003
- Appointed to Water Science and Technology Board, National Academy of Sciences, Washington. June 2001.
- Named by the BBC as a "Visionary on the Environment" in its Essential Guide to the 21st Century. 2001.
- Elected Academician of the International Water Academy, Oslo, Norway. October 1999.
- Awarded MacArthur Foundation Research and Writing Fellowship. International Peace and Security Studies, 1988-1990.
- Awarded Social Science Research Council-MacArthur Foundation Post-Doctoral Fellow in International Security. 1986-1988.

- Named San Francisco Chronicle, one of "90 People to Watch in the '90s." 1990.
- Achieved *Cum laude*, Yale University 1978; *Distinction*, Engineering and Applied Science. 1990.

PUBLIC AND PROFESSIONAL SERVICE

- Appointed to California Climate Change Technical Advisory Group, 2007-
- Elected member: AAAS Atmospheric and Hydrospheric Sciences Section: February 2007-2011
- Vice Chair, American Geophysical Union Global Environmental Change Focus Group, 2006-2008
- United Nations-Sigma Xi Scientific Expert Group on Climate Change and Sustainable Development, 2004-present.
- Water Science and Technology Board, National Academy of Sciences, 2001-present.
- Advisory Committee: Rethinking Water Policy Opportunities in California, UCSB/Rand Research, 2005-present.
- Public Advisory Committee: California Water Plan 2003. Department of Water Resources, 2001-present.
- Board of Directors: Pacific Institute for Studies in Development, Environment, and Security, 1988-present.
- Editorial Board: Senior Advisory Council. Environmental Research Letters, 2006-2008.
- Editorial Board, Annual Reviews of Energy and the Environment, 2001-2004
- Editorial Board, Climatic Change, 1990-present.
- Editorial Board, Water Policy, 1997-present
- Advisory Council, International Water Academy, Oslo, Norway, 2003-2005.
- Scientific Advisor: IMAX Film "The Water Planet," 2003-present.
- Advisory Board: Documentary film "Thirst," 2002-2004.
- Co-Chair: Water Sector: National Assessment of the Potential Impacts of Climatic Variability and Change on the United States, 1998-2000.
- Board of Directors: International Water Resources Association, 1997-2000.
- Global Environmental Change Committee, American Geophysical Union, 1993-1998.
- Public Advisory Forum: American Water Works Association, 1993-1998.
- 1990 Water Task Group, Second World Climate Conference, Geneva, Switzerland.
- Advisor, Comprehensive Freshwater Assessment, Stockholm Environment Institute, 1996-1997.
- Advisory Board: Documentary film "Cadillac Desert," 1995-1997
- Advisory Committee: Climate Institute's Environmental Refugee Program, 1993-1995.
- Board of Directors: Environmental Science and Policy Institute, 1991-1997.
- Climate and Water Panel, American Association for the Advancement of Science, 1986-1990.
- Co-Chair, Working Group 2, Advisory Group on Greenhouse Gases (AGGG), WMO/UNEP, 1989-91.
- Committee on Science & International Security, American Association for the Advancement of Science, 1993-95.
- Editorial Board, Environment and Security, 1993-2001.
- Editorial Board, Encyclopedia of Life Support Systems, 1997-2002.

- Editorial Board, Encyclopedia of Global Change (Oxford University Press), 1996-2000.
- Editorial Board: Global Change and Human Health, 1999-2003
- Interim Board of Directors: Middle East Water Information Network, 1994-1996
- Project Steering Committee: IUCN (World Conservation Union): Water Demand Management in Southern Africa, 2000-2003.
- Scientific Review Group, President's Council on Sustainable Development, 1994-1996.
- Surface Water Committee, American Geophysical Union, 1992-1993.
- Working Group VIII Special Report, United States-Soviet Agreement on Protection of the Environment, 1989-1990.

A full publications list is available upon request.