Contents

Contents ................................................................. iii

Authors .................................................................. v

Statement of Purpose .............................................. vii

Introductions ........................................................... ix

Acknowledgements ................................................ xi

Water Year 2003: A Fairly Good Year in Northern California, But a Non-traditional El Niño .................................................. 1
Maurice Roos

High Resolution Climate of the Past 3,500 Years of Coastal Northernmost California ...................................................... 13
John A. Barron, Linda E. Heusser, and Clark Alexander

Spatial and Temporal Variability in Snowpack Controls: Two Decades of SnoTel Data from the Western U.S. ......................... 23
Mark Losleben and Nicholas Pepin

Assessment of Environmental Influences on California Commercial Fish and Invertebrate Landings ................................. 33
Jerrold G. Norton and Janet E. Mason

A Comparison of Free-Air and Surface Temperature Trends at High Elevations in the Mountainous West of the U.S.................. 41
Nicholas C. Pepin, Mark Losleben, and Mike Hartman

Air Temperature and Snowmelt Discharge Characteristics, Merced River at Happy Isles, Yosemite National Park, Central Sierra Nevada .... 53
David Peterson, Richard Smith, Stephen Hager, Daniel Cayan, and Michael Dettinger

A Late Pleistocene-Holocene Pollen Record of Vegetation Change from Little Willow Lake, Lassen Volcanic National Park, California .... 65
G. James West
Authors

Clark Alexander
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411

John A. Barron
US Geological Survey, MS910,
Menlo Park, CA 94025

Daniel Cayan
Scripps Institution of Oceanography, 0224
La Jolla, CA

Michael Dettinger
Scripps Institution of Oceanography, 0224
La Jolla, CA

Stephen Hager
United States Geological Survey
345 Middlefield Road, MS 496
Menlo Park CA 94025

Mike Hartman
Cooperative Institute for Research in Environmental
Sciences
University of Colorado at Boulder
216 UCB, Boulder CO 80309-0216

Linda E. Heusser
Heusser & Heusser, Inc.
100 Clinton Rd.
Tuxedo, NY 10987

Mark Losleben
Mountain Research Station, University of Colorado
818 County Road 116
Nederland, CO 80466

Janet E. Mason
Pacific Fisheries Environmental Laboratory,
Southwest Fisheries Science Center / NMFS
1352 Lighthouse Ave.,
Pacific Grove, CA 93950

Jerrold G. Norton
Pacific Fisheries Environmental Laboratory,
Southwest Fisheries Science Center / NMFS
1352 Lighthouse Ave.
Pacific Grove, CA 93950

Nicholas C. Pepin
Department of Geography, University of
Portsmouth, U.K.
Buckingham Building,
Lion Terrace, Southsea, U.K. PO5 3NP

David Peterson
United States Geological Survey
345 Middlefield Road, MS 496
Menlo Park CA 94025

Maurice Roos
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Richard Smith
United States Geological Survey
345 Middlefield Road, MS 496
Menlo Park CA 94025

G. James West
United States Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825
Statement of Purpose

In 1984, a workshop was held on the “Climatic Variability of the Eastern North Pacific and Western North America.” From it has emerged an annual series of workshops held at the Asilomar Conference Grounds at Pacific Grove, California, or the Wrigley Institute for Environmental Studies at Two Harbors, Santa Catalina Island, California. These annual meetings, which involve 80-100 participants, have come to be known as the Pacific Climate (PACLIM) workshops, reflecting broad interests in the climatologies associated with the Pacific Ocean and western Americas in both the northern and southern hemispheres. Participants have included atmospheric scientists, hydrologists, glaciologists, oceanographers, limnologists, and marine and terrestrial biologists. A major goal of PACLIM is to provide a forum for exploring the insights and perspectives of each of these many disciplines and for understanding the critical linkages between them.

PACLIM arose from a growing concern about climate variability and its societal and ecological impacts. Storm frequency, snow pack, droughts and floods, agricultural production, water supply, glacial advances and retreats, stream chemistry, sea surface temperature, salmon catch, lake ecosystems, and wildlife habitat are among the many aspects of climate and climatic impacts addressed by PACLIM workshops. The workshops also address broad concerns about the impact of possible climate change over the next century. From observed changes in the historical records, the conclusion is evident that climate change will have major societal impacts through effects on global ecology, hydrology, geology, and oceanography.

Our ability to predict climate, climate variability, and climate change critically depends on an understanding of global processes. Human impacts are primarily terrestrial in nature, but the major forcing processes are atmospheric and oceanic in origin and transferred through geologic and biologic systems. Our understanding of the global climate system and its relationship to ecosystems in the eastern Pacific area arises from regional study of its components in the Pacific Ocean and western Americas, where ocean-atmosphere coupling is strongly expressed. Empirical evidence suggests that large-scale climatic fluctuations force large-scale ecosystem response in the California Current and in a very different system, the North Pacific central gyre. With such diverse meteorologic phenomena as the El Niño–Southern Oscillation and shifts in the Aleutian Low and North Pacific High, the eastern Pacific Ocean has tremendous global influences and particularly strong effects on North America. In the western United States, where rainfall is primarily a cool-season phenomenon, year-to-year changes in the activity and tracking of North Pacific winter storms have substantial influence on the hydrological balance. There are abundant climatic records, both instrumental and proxy, for this region. Recent research efforts are beginning to focus on better paleoclimatic reconstructions that will put present day climatic variability in context and allow better anticipation of future variations and changes.

The PACLIM workshops address the problem of defining regional coupling of multiple elements as affected by global phenomena. Because climate expresses itself throughout the natural system, our activity has been, from the beginning, multidisciplinary in scope. Our interdisciplinary group uses diverse time series, measured both directly and through proxy indicators, to study past climatic conditions and current processes in this region. The specialized knowledge from different disciplines has allowed for the synthesis of climatic records and process measurements to better understand the complete system.
Characterizing and linking the regional geosphere, biosphere, and hydrosphere provides a scientific analogue and, hence, a basis for understanding similar linkages in other regions and for anticipating the response to future climate variations. Our emphasis in PACLIM is to study the interrelationships among diverse data. To understand these interactive phenomena, we incorporate studies that consider a broad range of topics both physical and biological, time scales from months to millennia, and space scales from single sites to the entire globe.
Editor’s Introduction

Scott W. Starratt, US Geological Survey

In 2003, the Twentieth Annual PACLIM Workshop was held at the Asilomar State Conference Grounds at Pacific Grove, California. Situated on the beautiful windswept west coast, this was an ideal location for a conference on the climate of the eastern Pacific. Attended by more than 110 registered participants (see Appendix C, Attendees), this year’s workshop included 39 scheduled talks and 32 poster presentations. As a twentieth anniversary bonus, a special dinner was held at the Monterey Bay Aquarium.

Following the United Nations designation of 2002 as the “International Year of the Mountain”, the organizing committee (Mike Dettinger, US Geological Survey; Henry Diaz, Climate Diagnostics Center; Connie Millar, Pacific Southwest Research Station, Forest Service; Kelly Redmond, Western Regional Climate Center; Scott Starratt, US Geological Survey) assembled presentations aimed at evaluating past, present, and future trends in temperature and precipitation in the mountainous regions of western North America into a special session entitled “Integrated Climate Research in the Mountains” (see Appendix A, Agenda).

On the first evening, Kelly Redmond gave us an overview of the western weather and climate for the 2002-2003 “PACLIM YEAR” and Maury Roos presented the 2003 California Water Year report. In a change from the usual data-oriented presentations, Didier Sornette gave a more philosophical presentation on the endogenous and exogenous origins of crises, both natural and anthropogenic. In keeping with the theme of the special session, the Monday evening presentation by Lonnie Thompson explored recent contributions from ice cap records in Asia, South America, and Africa. For the Tuesday evening talk by Julio Betancourt, we moved toward the western coast of South America for a discussion of the late Quaternary history of the Atacama Desert and the Pacific slope of the central Andes.

Poster presentations were displayed throughout the meeting and time was set aside on Tuesday evening for their presentation and discussion (see Appendix B, Poster Presentations).

All presenters were invited to expand their abstracts into a manuscript for inclusion in the 2003 PACLIM proceedings volume, along with the abstracts from the oral and poster presentations. In this Proceedings volume, seven full-length papers are presented. The papers were not formally peer reviewed and editorial comments are generally limited to grammar, spelling, and format. Editorial comments on the content of some submissions have been offered, but any errors in fact or logic are the responsibility of the author(s).

Special Session Introduction—Integrated Climate Research in the Mountains

The goal of this year’s special session was to highlight some of the recent work in past (pre-historic), historic past, and present rates and magnitudes of climate change in the western cordillera. Discussions covered all of the major mountains in western North America. General topics included:
1) overall variations in mountain climates and the means of monitoring these changes, 2) specific changes in the alpine cryosphere, 3) how do changes in mountain climates affect local and regional water flow and water quality, 4) what effect will these changes have on surficial processes, and 5) what impact will these changes have on the rate and magnitude of ecosystem transformation.

In Part I of this session (“Paleo Perspectives”), the majority of the presentations reviewed high elevation climatic variation through ecosystem change and the role played by fire. Ice core, glacier ice volume, tree-ring analysis, reconstructed stream flow variation, and lacustrine records rounded out the session. In Part II (“Rather Recent”) instrumental records were discussed in the context of the causal mechanisms for regional temperature variations at low and high elevations, the role of snow pack in controlling high elevation temperatures, and the close relationship between hydrologic state variables and winter forecasts. Part III (“Looking Ahead”) reviewed a number of the regional monitoring systems that were currently in place and ended with a panel discussion that looked at the options for expanding mountain climate research.
Acknowledgements

For two decades, PACLIM workshops have been run by volunteers who always manage to put together a timely and topically interesting gathering for a wide range of researchers. The 2003 workshop drew more than 100 participants with many first-time attendees, a strong indication that PACLIM continues to provide an exciting forum for new ideas, information, and concepts.

For 2003, thanks go to the following people and institutions: Mike Dettinger (US Geological Survey), Program Chair, Henry Diaz (Climate Diagnostics Center), Connie Millar (Pacific Southwest Research Station, Forest Service), Kelly Redmond (Western Regional Climate Center), Scott Starratt (US Geological Survey); and Janice Tomson, Meeting Organizer, who was ably assisted by Canie Brooks, Olga Katsuk, and Keith Mootsey (Long Beach City College).

Sponsorship and funding for the workshops come from a wide variety of sources. This year’s PACLIM Workshop was sponsored by the US Geological Survey Water Resources Discipline (Bill Kirby), NOAA Office of Global Programs (Harvey Hill), CALFED Bay-Delta Science Program (Sam Luoma), US Navel Postgraduate School (Tom Murphree), California Department of Water Resources (Zach Hymanson), Forest Service Pacific Southwest Research Station (Hilda Diaz-Soltero), and US Geological Survey Geologic Discipline Earth Surface Dynamics Program (Martha Garcia).

For the sixth year Mike Dettinger oversaw the organization of the meeting program and maintained the website. As in previous years, Janice Tomson did a superb job of planning, organizing, and supervising the logistics of the meeting (getting us there, accommodated, and fed), and, with help from her Long Beach City College students, Janice ably handled the numerous details that need to be taken care of for a successful meeting. Lucenia Thomas, (U. S. Geological Survey Water Resources Discipline) arranged travel and assisted in the meeting organization. Tom Murphee (Naval Postgraduate School) provided and set up the audiovisual equipment. The seven meeting moderators (Dan Cayan, Mike Dettinger, Henry Diaz, John Dracup, Connie Millar, Scott Starratt, Jim West) are also gratefully acknowledged. Finally, we thank all our speakers and poster presenters (listed in the agenda) for their contributions and enthusiasm.

For the editing, production, and printing of the proceedings, thanks go to the California Department of Water Resources and the US Bureau of Reclamation’s Interagency Ecological Program for the Sacramento-San Joaquin Estuary. This volume was produced by my co-editor, Nikki Blomquist, whom I thank for her special expertise and knowledge. John Barron and Elmira Wan greatly improved the introductory remarks.

The precedents for the 2003 volume were established by the previous editors of the PACLIM Proceedings: Dave Peterson (1984-1988), with the able assistance of Lucenia Thomas Julio Betancourt and Ana MacKay (1989-1990), Kelly Redmond and Vera Tharp (1991-1993), Caroline Isacs and Vera Tharp (1994-1996), Ray Wilson and Vera Tharp (1997), Ray Wilson and Lauren Buffaloe (1998), and G. James West and Lauren Buffaloe (1999-2001), and James West and Nikki Blomquist (2002). It was Jim West’s arm-twisting, starting at the American Quaternary Association meeting in August 2002, which resulted in the most recent change in editorship. Is there anybody’s arm out there I can twist?

Scott W. Starratt
US Geological Survey
Menlo Park, CA