

The Sierra Nevada Research Institute University of California, Merced





SIERRA NEVADA

RESEARCH

INSTITUTE

AT UC MERCED

THE SIERRA NEVADA RESEARCH INSTITUTE

THE SAN JOAQUIN VALLEY is recognized around the world for its leadership in agricultural production. The Sierra Nevada is known for its spectacular landscapes and its many recreational and biological resources. Together, these regions of California are legendary for their vast natural resources, physical and biological diversity, and cultural heritage.



HOWEVER, rapid population growth, competition for natural resources, air, water and soil pollution, and competing land uses pose serious threats to the sustainability of these regions. Solving these problems requires the combined perspectives of a number of disciplines and multidisciplinary research efforts at the interface of traditional disciplines. UC Merced, the first UC campus in the San Joaquin Valley, is addressing these problems with the Sierra Nevada Research Institute (SNRI). Indeed, the San Joaquin Valley and the Sierra Nevada serves as the “outdoor laboratory” for the SNRI.



THE MISSION of Sierra Nevada Research Institute is to discover and disseminate new knowledge that contributes to sustaining natural resources and promoting social well being in the San Joaquin Valley and Sierra Nevada Regions of California, and related regions worldwide, through integrated research in the natural, social, and engineering sciences.

The mission of the Sierra Nevada Research Institute will be accomplished through:

- Collaborative, multidisciplinary, basic research conducted by faculty, students, staff

and affiliated scientists in natural science, engineering and social sciences.

- Strong interactions with related research units within the UC system and close collaborative relations with scientists and managers at national laboratories, and local, state, and federal agencies including the National Park Service.
- Connecting objective, science-based data and information with public and private stakeholders.



THE SNRI is being organized around an Earth Systems Science model. This model combines the earth sciences (soils, geology, water and atmospheric sciences), with biological sciences (ecology and molecular biology), engineering (environmental engineering and hydrology) and social science (economics and policy) in integrated studies of complex problems at the systems level. A particular emphasis will be placed on the physical and biological connections that exist between the Central Valley and Sierra Ecosystems. Through these balanced research efforts, the SNRI will serve as a source of objective scientific information for public policy makers as California faces the growing challenge of sustaining the integrity and quality of its resources into the future.

Current UC Merced Faculty Research Topics

- climate change and ecosystem health
- contaminant transformations in soils and aquatic systems
- development of environmental sensors
- hydrologic processes in the Sierra Nevada
- nutrient transport in agricultural and natural systems
- water and air quality in the Valley basin and the Sierra Nevada Range
- computational ecology and biodiversity



Sierra Nevada Research Institute
at UC Merced
P.O. Box 2039
Merced, CA 95344
(209) 724-4311
www.ucmerced.edu

THE SIERRA NEVADA RESEARCH INSTITUTE

1. INTRODUCTION

The University of California opened its tenth campus, UC Merced, to undergraduates in Fall 2005. UC Merced enrolled ~900 undergraduate and graduate students on opening day, growing to 25,000 students at build-out. In 1998 lead planners for UCM convened a meeting of Directors from several UC Multi-campus Research Units to discuss possible UCM research initiatives. Discussions focused on research themes especially well suited to the campus location at the nexus of the Great Valley and Sierra Nevada regions. From initial discussions there emerged the concept of the Sierra Nevada Research Institute (SNRI), a new multidisciplinary research unit focused on environmental and social issues of greatest importance to the stakeholders of these regions. In 2002, the Founding Director of SNRI was hired and since that time has assisted the School Deans in recruiting and hiring the first UCM faculty, in particular, those who are members of the institute. These individuals have a strong focus in environmental science and engineering. With this document, the Founding Director and the current SNRI faculty are formally proposing the designation of SNRI as an Organized Research Unit (ORU) at UC Merced.

2. MISSION

The mission of the Sierra Nevada Research is to discover and disseminate new knowledge that contributes to sustaining natural resources and promoting social well being in the San Joaquin Valley and Sierra Nevada regions of California, and related regions worldwide, through integrated research in natural science, social science, and engineering.

This mission will be accomplished through:

- *Collaborative, multidisciplinary research conducted by faculty, students, staff in the School of Natural Science, the School of Engineering, and the School of Social Science, Humanities and Arts at UCM;*
- *Strong interactions with related research units within the UC system and close collaborative relations with scientists and managers at national laboratories (particularly LLNL) and local, state, and federal agencies;*
- *Creation of research facilities on the UCM campus and within the San Joaquin Valley and Sierra Nevada regions of California,*
- *Extensive sharing of SNRI data and information with public and private stakeholders,*
- *Sharing research results with local and regional stakeholders through public forums and workshops.*

3. VALUE OF A SIERRA NEVADA RESEARCH INSTITUTE

The Sierra Nevada is known for its spectacular landscapes and its many recreational and biological resources. The San Joaquin Valley is recognized around the world for its leadership in agricultural production. Together, these regions of California are legendary for their vast natural resources, physical and biological diversity and cultural heritage.

However, rapid population growth, competition for natural resources, air, water and soil pollution, and competing land uses pose serious threats to the sustainability of these regions.

Over the next twenty years the populations of the San Joaquin Valley and Sierra Nevada Regions are projected to increase by 2.5 million and 1 million residents, respectively; a rate nearly 20% higher than the projected statewide average. Population growth in the San Joaquin Valley could convert 20% of current cropland to urban use by the year 2040. If current development patterns continue, low density housing in the Sierran foothills would consume half of all private land in the region by 2040, fragmenting habitats and creating enormous safety concerns due to wildfire. Public lands are also under increasing pressure. For example, Yosemite National Park now accommodates between three and four million visitors every year, including nearly one-quarter million overnight stays.

Since 1990 there have been repeated calls for a Sierra Nevada Research Center that could help address regional ecological and social issues by conducting and coordinating regionally-focused, issue-oriented research while disseminating data, information and analytical tools to local stakeholders.¹ Moreover, population growth, land use change, and environmental sustainability are issues not just for California, but also for most areas of the globe. Thus, although regionally focused, the Sierra Nevada Research Institute will pursue general principles and theory. This will be promoted through comparative studies in other areas, notably Mediterranean-climate regions facing many of the same issues (e.g., the Cape Region of South Africa, the Mediterranean Basin, Chile), and through cooperative research and exchange programs established and fostered through formal institutional agreements.

A Sierra Nevada Research Institute will continue to be a boon to the new campus by supporting faculty recruitment efforts of individual academic departments while signaling UCM's commitment to innovative, multidisciplinary research and teaching programs that are rooted in the region. Importantly, a SNRI could also foster lasting, synergistic relationships between the campus and County, State and Federal agencies, as well as the private sector.²

¹ For example, in 1994 the Sierra Nevada Planning Team recommended creation of a research center that would be: independent, responsive to identified information needs, a repository for existing information, engaged in research that supports decision making, continue to develop new funding sources, and located in the region (Sierra Nevada Planning Team, 1994, "Critical questions for the Sierra Nevada: recommended research priorities and administration," Centers for Water and Wildland Resource Report 34).

² The interdisciplinary concept of SNRI follows a recent trend in UC to design institutions that promote engagement between the natural and social sciences (e.g., Berkeley's reorganization of several departments into Environmental Science, Policy, and Management, and Santa Barbara's opening of the Donald Bren School of Environmental Science and Management).

4. RESEARCH FOCI

The SNRI will conduct basic and applied research as it relates to key regional natural resources and environmental processes and issues. The intellectual enterprise will be tightly coupled with place, built on an infrastructure of data and models. Much of the research will be focused on the central and southern Sierra Nevada and the San Joaquin valley. Of particular interest will be issues that emphasize the connectivity between these two geographic regions. Many environmental problems relevant to the Sierran Nevada and the San Joaquin Valley span from molecular to landscape scales. Thus, scaling will be an important component of SNRI efforts.

The SNRI Director and initial faculty will be responsible for defining the Institute's research agenda. This will result from a comprehensive consideration of regional research needs and opportunities, faculty interest and availability of funding. The following are intended to serve as examples of research foci that could support environmental policy development and resource management:

KEY REGIONAL BIOLOGICAL PHYSICAL AND ECOSYSTEM PROCESSES;

- Physical, chemical and biological bases of California ecosystems
- Ecosystem consequences of regional climate change
- Water resources and biodiversity
- Biodiversity and ecosystem function
- Invasive species and ecosystem dynamics
- Habitat fragmentation, ecosystem processes, and wildlife population dynamics
- Air resources, air quality and ecosystem stability
- Fire, fuels and watershed function
- Geohazards and land use

KEY SOCIAL PROCESSES;

- Population growth and land use change
- Cultural diversification and changing use of public lands
- Water management and use
- Transportation systems
- Corporate environmental management

ENVIRONMENTAL INFORMATION SYSTEMS;

- Field computing
- Integrated remote sensing of social and ecological processes
- Data assimilation for regional atmospheric, hydrologic and ecosystem models
- Decision support systems for watershed and regional planning

RESEARCH SYNTHESIS AND POLICY ANALYSIS;

- Monitoring and adaptive management of Sierran ecosystems
- Sustainable development of the Great Valley and Sierran foothills
- Wildfire policy and management in rural and suburban environments
- Watershed management, water quality and quantity, and integrity of aquatic ecosystems

The current research activities of faculty and students affiliated with SNRI are oriented around issues of water quality and hydrology. Initial research projects include:

Contaminant fate and transport in Sierran Foothill and San Joaquin Valley surface and groundwater.

Relationship between mountain block recharge and surface water in Sierran rivers

Microbial diversity in elevation transects in the Sierra's

C cycle research in orchard production systems

Studies of atmospheric nanoparticles

Establishment of an environmental sensor network in the San Joaquin River watershed

Establishment of a hydrologic observatory in the Sierra Nevada.

This research portfolio will expand as additional faculty are hired.

5. SNRI ORGANIZATION

The personnel of the SNRI include a Director, affiliated faculty, support staff, postdoctoral researchers, and student researchers. Visiting scholars are also expected to play an important role. SNRI is designed to support the overall development of UC Merced. This requires close coordination with other UCM campus development efforts, and has included recruiting some established leaders for the SNRI faculty. These individuals are helping to build programs in their respective disciplines, thereby ensuring that the Institute is integrated into the larger intellectual enterprise of the campus.

The SNRI is organized around an ecosystems model. This model combines the earth sciences (hydrosphere, cryosphere, lithosphere, atmosphere), with biological sciences (biosphere, ecology molecular biology and genomics), engineering (environmental engineering and computer science) and social science (economics and public policy, etc.) in integrated studies of complex problems at the systems level. Through these balanced research efforts, the SNRI will serve as a source of objective scientific information as California faces the growing challenge of sustaining the integrity and quality of its human and natural resources into the future.

The Institute functions as an Organized Research Unit (ORU), in which the Director (a tenured faculty member) holds a fulltime appointment, and whose ladder-rank faculty researchers hold full appointments in their respective Schools.

Internal Advisory Committee: A faculty Advisory Committee shall provide counsel to the Director on all matters pertaining to the unit, including budgetary matters and personnel. The Advisory Committee shall consist of 3 to 5 faculty members, appointed by the Executive Vice Chancellor.

Director's Advisory Committee – External: An External Advisory Committee comprised of individuals from the public and private sectors will provide the Director with advice on research issues of relevance to the region.

Staff: SNRI will depend critically on adequate staffing to cover administrative, laboratory and operations support: Current SNRI staff consist of:

Position	FTE	Incumbent
Director	1.0	S. Traina
Administrative Assistant to the Director:	0.5	S. Rodriquez
Analyst	0.5	T. Vicari
Yosemite Station Manager	1.0	VACANT

T. Vicari will become fulltime Grants and Contracts Officer for the Vice Chancellor of Research (VCR) in fiscal year '05-06. The 0.5 FTE appointment currently allocated to her will be reallocated to another position in SNRI. Similarly, the Director's administrative assistant is currently shared with the VCR (with 0.5 FTE attributed to SNRI). When the Director and the VCR move to campus, they will no longer be located in the same building and it will not be possible to share an administrative assistant. Thus, this appointment will be increased to 1.0 FTE in SNRI and will provide support to both the Director and other SNRI personnel. Additional positions that will be needed over the next five years include:

Sequoia/Kings Canyon Station Manager	1.0
MSO	0.5
Education and Outreach Coordinator	0.5
Administrative Assistant (personnel support)	1.0
Environmental Analytical Laboratory Manager ³	0.5

After filling these positions and adjusting appointments as described above the total FTE's allocated to SNRI would reach 5.5, within five years.

6. LOCATION AND FACILITIES

The institute will be headquartered in the first Science and Engineering (S&E1) building, at the UC Merced campus and will have associated laboratory and field research sites in the Great Valley and Sierra Nevada region. Faculty and students in the Schools of Natural Science and Engineering will be housed within S&E1, while those in the School of Social Science, Humanities and Arts will be housed in the first classroom building.

The SNRI will operate the Environmental Analytical Laboratory (EAL), to be located in S&E1. This is a campus-wide multi-user facility dedicated to environmental, chemical analyses. Major instrumentation in this laboratory includes an inductively-coupled plasma (ICP) mass spectrometer, an optical emission ICP, a graphite furnace atomic absorption spectrometer, a microwave digestion system, a gas chromatograph-mass spectrometer – mass-spectrometer, a dissolved C analyzer and two ion chromatographs. User fees (rates to be determined) will offset some of the operating and maintenance costs of these instruments. A funding mechanism for the laboratory manager is currently under development. It is envisioned that this position will be funded in part by recharge dollars with the remainder of support coming from UC Merced central funds.

SNRI affiliated faculty are working on NSF proposals to add analytical equipment to the EAL. Over the next 5 years, they envision acquisition of an X-ray diffractometer, a LC-MS and a capillary electrophoresis-MS. These and other instruments will be added to the EAL as grant dollars and/or gift money become available.

In May 2004, Yosemite National Park and SNRI dedicated the first SNRI field station located in Wawona. This 1400 ft² facility will provide logistical support for academic field research and outreach activities in YNP. This facility will be supplemented with a residence for the Station Manager (an SNRI employee) and a bunkhouse in fiscal year 2005-2006. In 2004, UCM also renewed its MOU with Sequoia-Kings Canyon and Yosemite National Parks, which commits all parties to establish an SNRI field station in Sequoia-Kings Canyon National Park. The field stations will be available for use by faculty, staff and students of the University of California, as well as the larger academic community. We currently estimate the annual operating costs for each field station, the associated residence for each station manager and the bunkhouse at each location at \$39,000 (per location). User fees will offset some of the operating costs of these facilities. The user fees will be set at a level commensurate with other UC field stations (e.g. UC

³ The 0.5 FTE for this appointment is a reallocation of T. Vicari's current 0.5 FTE.

Natural Reserve sites, White Mountain Research Center), subject to approval of the UC Merced Recharge Committee.

The SNRI will have extensive needs in the area of research computing and computational infrastructure. Many of the current and planned research activities will generate large, complex data sets.

7. EDUCATIONAL PROGRAMS

The SNRI will not offer graduate or undergraduate courses. At present, two undergraduate degrees are currently associated with SNRI faculty, Earth Systems Science (in the School of Natural Science) and Environmental Engineering (in the School of Engineering). The Environmental Systems graduate group is dominantly comprised of SNRI faculty. Much of the research and course work in these majors will draw heavily from the research portfolio of SNRI. Additionally, it is anticipated that both undergraduate and graduate courses will make use of the Wawona field station.

SNRI will partner with the National Park Service, state agencies and private groups to further outreach education in the areas of environmental science and policy. These efforts will serve to increase the visibility of UC Merced faculty and students concomitant with increasing enrollment in Earth Systems Science, Environmental Engineering and Environmental Systems.

Faculty in SNRI have already participated in a hydrology course for grades 6-12 science faculty from the San Joaquin Valley, the Bay Area and Southern California and a hydrology and aquatic chemistry course for high school students from the Merced High School District.

8. FOUNDING SNRI MEMBERS

The following UC Merced faculty and research affiliates have agreed to participate as SNRI members:

Name	School
<i>Faculty</i>	
Roger Bales	Engineering
Martha Conklin	Engineering
Phil Duffy	Natural Science
Jessica Green	Natural Science
Qinghua Guo	Engineering
Tom Harmon	Engineering
Shawn Kantor	SSHA
Valerie Leppert	Engineering
Peggy O'Day	Natural Science
Sam Traina (Director)	Nat. Science & Engineering
Christopher Viney	Engineering
Jeff Wright	Engineering
<i>Affiliated Researchers</i>	
German Gavilan	Assist. Dean Engineering
Sarah May	Postdoctoral Investigator
Virginia Ramon	Postdoctoral Investigator
Robert Rice	Research Scientist
Shankar Sarkar-Sharma	Research Scientist
Domenik Wolff-Boenisch	Postdoctoral Investigator
Yiguo Zhang	Postdoctoral Investigator

Collaborative Activities:

There has already been a considerable amount of synergistic activity amongst the members of SNRI. Professors O'Day, Leppert and Traina submitted a successful research proposal to NSF to fund the purchase of an Environmental Scanning Electron Microscope. Professors Harmon, Bales and Traina have obtained a planning grant from NSF to develop an integrated sensor network to study water quality and hydrology in the San Joaquin watershed and Professors Bales, Conklin, Harmon and Traina are preparing a large, multi-investigator proposal to NSF for the establishment of a Hydrologic Observatory in the Sierra Nevada. Additionally, Professors Wright, Bales, Conklin, Harmon, O'Day and Traina are discussing a large research project with a local irrigation drainage district on the Westside of the San Joaquin Valley. Professor Kantor, along with colleagues in Natural Science and Engineering, are exploring diverse research projects on the political economy of water use in California. Current research proposals include a history of water use in the Sierra Nevada region and Central Valley, economic analyses of the costs and benefits of large-scale reclamation and irrigation projects in the region, and analyses of

the legal and economic issues surrounding the transfer of water rights among stakeholders. Professors Leppert and Traina are also exploring opportunities to conduct air quality research with investigators in Yosemite National Park. Clearly this group of individuals has developed a collaborative, interdisciplinary research program. It is anticipated that the scope, magnitude and breadth of this research will expand as faculty in the areas of ecology and atmospheric science join UCM and SNRI.

9. RELATED UNITS IN UC

Environmental research and education programs are located each of the other eight general campuses of the University of California. These include specific undergraduate and graduate degree programs, research centers and institutes, ORUs and one MRU. Eight programs that have the greatest overlap with the SNRI are discussed below. These descriptions were obtained from websites in the Office of the President and from websites for each of the programs.

- *Institute of the Environment (IoE) - UCLA*: This non-MRU, non-ORU is an autonomous unit that works campus-wide at UCLA to facilitate environment-related teaching, research and community outreach. Its stated objectives are: 1) to develop multidisciplinary academic programs that address the full breadth of environmental issues facing today's society; 2) to stimulate innovative and integrative interdisciplinary research on local, regional, and global environmental processes; and 3) to use collaborative problem-solving to strengthen UCLA's effectiveness in serving the community. The IoE currently has five research subgroups, *The Coastal Center*, the *Tropical Research Center*, the *Urban Center for People and the Environment*, the *Southern California Particle Center and Supersite*, the *Center for Air Pollution and Exposure*. The four latter subgroups focus on issues of specific regional significance to Southern California.
- *Institute for Innovation in Environmental Research (STEPS) - UCSC*: This non-MRU, non-ORU is a campus-wide effort to link Science, Technology, Engineering, Policy and Society. It is focused on anthropogenic induced climate change, genetic restructuring of ecosystems caused by the global transport of species and changing global environments, and the transformation of earth's major water systems through alteration of rivers and lakes, increased use of oceanic resources, and diffusion of environmental toxins.
- *National Institute for Global Environmental Change - UCD*: This federally funded, non-MRU, non-ORU is one of six U.S. DoE-funded regional centers that are committed to interdisciplinary academic research that increases the understanding of global environmental and climate change.
- *The Center for Ecological Health Research – UCD*: The Center for Ecological Health Research (non-MRU, non-ORU) is one of four environmental research centers funded nationwide by United States Environmental Protection Agency, National Center for Environmental Research and Quality Assurance. The center brings together scientists from many disciplines to study transport and fate, ecology and toxicology in specific watersheds (the Sacramento river, the Lake Tahoe basin and Clear Lake). The combining of disciplines to focus on these specific geographic areas provides an infrastructure to promote long-term multi-process-environmental studies that more closely reflect the ways ecosystems function. The central goal of the center is to understand how multiple stresses interact to affect

biological and ecological processes in aquatic and terrestrial systems. Natural stresses such as drought, salinity, and climate change and anthropogenic stresses such as toxic compounds, nutrients, species introductions and habitat destruction are cumulative impacts on ecosystems.

- *John Muir Institute of the Environment – UCD*: This ORU is a center of excellence for research and outreach programs related to the biological, physical, and human environment. The Institute encourages and facilitates interdisciplinary environmental research and outreach programs on the Davis campus. It provides an administrative home for existing and proposed research centers and focused workgroups related to the environmental sciences; and it coordinates with environmental extension units and graduate groups as appropriate. Affiliated Research Programs include, *the Aquatic Ecosystems Analysis Laboratory*, the *Center for Health and the Environment*, the *Center for Integrated Watershed Science and Management*, the *Center for Natural Resources Policy Analysis*, the *Information Center for the Environment*, the *Public Service Research Program*, the *Putah-Cache Bioregion Project*, the *Road Ecology Center*, the *Tahoe Research Group and Castle Lake Limnological Research Station* and the *UC Davis Natural Reserve System*.
- *Institute for Environmental Science and Engineering – UCB*: This ORU has current research programs in sanitary engineering and environmental health research. Traditional areas of activity include water and waste-water treatment systems, water reclamation and reuse, the impact of water quality on aquatic ecosystems, the impact of environmental contamination to human health, indoor air quality monitoring, industrial hygiene and ergonomics and biomechanics. The Mission of the Institute for Environmental Science and Engineering is to support research and teaching in the sciences and technology that are essential to understand and improve the environment. The Institute is multi-disciplinary and included not only a broad representation of the engineering disciplines but also a wide variety of other natural and social sciences. It plays an increasing role as a bridge between basic research, often associated with an academic environment, and the more applied studies necessary for sound environmental management.
- *Institute for Research on Climate Change and its Societal Impacts (IRCCSI) - LLNL*: Improved understanding of the societal impacts of climate change, e.g. impacts on water resources, agriculture, human health, etc., is needed to inform policy decisions involving climate change and energy production. This MRU aims to provide that understanding by fostering collaborative research into the societal impacts of climate change. IRCCSI's *modus operandi* is to link the climate modeling capabilities at UC-operated labs and UC campuses with expertise in societal impacts, which is resident primarily at the campuses.
- *White Mountain Research Station – UCSD*: The White Mountain Research Station is a multicampus research unit (MRU) of the University of California Office of Research, with a campus office located at UC San Diego. The station includes a base facility (Owens Valley Lab; elevation 4000 ft.) located in high desert near the town of Bishop, as well as three facilities in the White Mountains: a montane station at Crooked Creek (elev. 10,200 ft.), an alpine station at Barcroft (elev. 12,500 ft.), and a remote high alpine lab on the summit of White Mountain Peak (elev. 14,250 ft.). The combination of facilities, geologic exposure,

high elevation and winter access make the station uniquely valuable for scientific study and educational purposes. The mission statement of the White Mountain Research Station is, “to provide room, board and facilities for any qualified research or educational group that wishes to utilize the Station’s high altitude laboratories or surrounding environment for research or field courses”, and “to be a UC Center of Excellence in “Environmental Science” focusing on high altitude and the Eastern Sierra/Western Great Basin regions”.

Each of the aforementioned programs has some thematic overlap with the SNRI. Additionally the White Mountain Research Station also operates field stations for investigators conducting mountain research. Nevertheless the aggregate of SNRI’s programs is unique. SNRI’s existing and proposed field stations in Yosemite and Sequoia/Kings Canyon National Parks are physical assets that will facilitate the research and education programs of SNRI faculty, students and investigators. Whereas, the SNRI would have the same research and education agenda without these facilities, the same is not true for the White Mountain Research Center, whose principal focus is to operate high altitude research centers.

Several of the programs listed above focus on various aspects of climate change, hydrology, water quality, atmospheric science, ecology and environmental policy and economics, but we are unaware of any other research program or institute within the University of California that attempts to link environmental research between the San Joaquin Valley and the Sierra Nevada range, nor one that is attempting to address each environmental issue from the molecular to the landscape scale. With the inclusion of faculty in the social sciences, we contend that SNRI will be able to focus on a unique range of topics that are otherwise inaccessible to UC faculty and students.

10. FIVE-YEAR RESEARCH PLAN

The SNRI is a faculty-based research institute. Its research activities will consist of a combination of traditional, individual investigator projects as well as large multi-investigator activities. We are still in a mode of active faculty recruitment in many areas that will fall under the research mission of SNRI. Thus, it is not possible to present a fully articulated five-year research plan. Nevertheless, it is clear that many of the broad research topics listed in Section 4 will become areas of emphasis over the next five years. The current faculty in SNRI are developing broad research programs exploring the interactions between hydrology, water resources, water quality, climate, and biota. As a group, we plan to study, the chemical, physical, biological and social connections between Sierra Nevada and San Joaquin Valley ecosystems. Particular emphasis is on the interconnections between Climate Change, Hydrology, Biogeochemistry and Ecosystem Science.