

CALIFORNIA NEVADA APPLICATIONS PROGRAM (CNAP) <http://meteora.ucsd.edu/cap/>

The two very different states of California (CA) and Nevada (NV) provide valuable opportunities to learn about vulnerability to climate changes and how they are accommodated by local, State and Federal decision makers. CA has the Nation's largest population and largest economy. NV ranks only 35th in population but is the fastest-growing state in the U.S. Both states have large diversities of topography, culture, and climate. Overall, NV is the driest of the United States, but both depend on snowmelt from the Sierra Nevada while also importing water. Most of CA's population is within 100 km of its 1350 km of coast, the scene of a sharp transition in climate. Seasonal and interannual variability of precipitation in the two states is amongst the largest in the U.S., with prominent floods and droughts. Both have warmed for the past 35 years, a recent impetus to improve adaptation strategies.

Over the past decade CA became the leading state advocating for proactive responses to climate change with a suite of adaptation and mitigation activities. Our RISA center, initiated in 1999 and formerly named "CAP", helped to spawn this interest, through many key research results and many more public presentations and visits to senior state staff. NV politicians have not embraced the climate issue as much, but pockets of interest are present, and growing, in the Great Basin.

CNAP has three major themes: 1) *Information and Tools for Adaptation*, 2) *Decision Support for Environmental Resource Management*, and 3) *Support for regional and state climate assessments*. Within these themes we undertake research projects that are aimed at informing **water resources, wildfire and land resource management, and coastal** decisionmakers.

To improve our knowledge of stakeholders and climate in the region, CNAP is in the midst of five key thrusts: 1) *Stakeholder engagement* across a broad spectrum; 2) *Education*, involving a broad portfolio of activities, formal and informal; 3) *Contributing to a national climate service*, by way of applying what we learn in CA/NV; 4) *Adaptation*, through understanding adaptation needs, and helping develop and evaluate usable applications for decision makers; 5) understanding how *observations and monitoring* can affect attitudes about climate change in different communities.

CNAP Core Team, with affiliations and major roles

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Core RISA Activities in FY10-11

1. Information and Tools for Adaptation.

* *Climate variability and change impacts in California and in the San Francisco Bay Area.* In collaboration with several other teams, we are engaged in an ongoing study of the vulnerability of the state and particularly the San Francisco Bay area to climate change. One of our major functions is to provide climate data, diagnostics and outreach for a new “San Francisco Bay Area Climate Impacts Adaptation Planning Campaign”, organized by the State of California and by the San Francisco Bay Region Joint Policy Committee. This study will address the impacts of sea level rise, extreme weather events, wildfires, and water shortages on natural systems and built environments.

* *Stakeholder Involvement in Climate Model Downscaling* CNAP and USGS have made a USGS cooperative agreement with the Climate Decision Support Consortium RISA at Oregon St. Univ. to collaborate on a new dynamical downscaling approach. This will develop and explore sensitivities of massive ensembles from regional climate-change models. We organized a CA stakeholders meeting to identify needed outputs, and a related workshop will investigate downscaling utility.

* *Coastal Management and Information Interactions* Projections of extreme sea levels will be shared with stakeholders to inform adaptation activities. For example, the combined storm-sanitary sewer system San Francisco and California port operation is vulnerable to small increases in sea levels. Infrastructure improvements would require billions of dollars. CNAP will participate in with the California Climate Action Team and the California Ocean Protection Council to better understand the state-of-the art in estimating global and regional sea level rise. CNAP will also develop, disseminate and evaluate coastal cloudiness, and study impacts of coastal vs. interior heat waves.

* *Regional Groundwater Management* CA relies heavily on groundwater resources to meet its large and growing water demands. Because pumpage and diversions are not routinely monitored, there has been a need to use regional hydrologic models to assess potential climate-change effects on proposed changes in water management policies and capital improvements in the Central Valley.

* *Evaluating the Role of Observations and Monitoring* This element aims to assess the role that observations play in promoting understanding and use of climate science by decision makers.

2. Decision Support for Environmental Resource Management

* *Climate and Wildfire* California and Nevada cope with significant wildfire activity. CA has substantial forest and urban domains, and hence has large areas of wildland-urban interface. The frequency of large wildfires in CA and other parts of the West has increased markedly in the last three decades, in response, partially, to drier forests caused by earlier springs and warm summers. Of the 22 USFS fires that exceeded \$10 million suppression costs in 2008, 17 were in CA. Direct human impacts from fire in CA include response costs, public safety, property loss and public health (smoke). NV also has some forest land, but a major fraction is dominated by sagebrush. Wildfire and land management agencies in CA and NV have indicated a need for climate information for short range and longer strategic planning and to help with developing adaptation strategies .

* *San Francisco Bay and watershed* The San Francisco Bay/Delta, the largest West Coast estuary, is a locus of population and infrastructure, a complex ecosystem, and the hub of CA water resources. CNAP will continue to provide climate guidance to the CALFED Bay-Delta Restoration Program and participate with USGS colleagues in their Computational Assessment of Scenarios of Change for the Delta Ecosystem project, which assembles a cascade of modelers ranging from climate to delta hydrodynamics to sediment transport to phytoplankton dynamics, invasives, contaminants, and fisheries.

* *Climate/Weather Extremes and Human Health* Excess deaths occurred during the 2006 and 2007 heat waves in CA. CNAP member Gershunov is collaborating with Cal. Dept. of Pub Health, [UC Davis Medical School](#) and the UCLA School of Public Health to investigate effects of climate on public health and mortality. Health impacts of recent heat waves will be compared to coroner's reports, hospital admissions and census tract demographic data. Stakeholder input will be used to understand a) effects of climate on public health and b) roles of social and demographic factors in modifying these effects. We will work to transfer findings to public health practitioners and report on lessons learned.

3. Support for Regional Climate Assessments

* *California and Nevada Climate Assessments* Over the next five years we will contribute to two more CA climate assessments. These assessment activities are bolstered by a growing program to understand CA's vulnerability to climate change, and by the development of tools and applications that can assist the state in performing assessments and in adaptation efforts. We hope to motivate parallel efforts in Nevada as well.

* *Energy, climate, and water.* Climate has a substantial effect on energy demand, with hot days in CA and NV contributing to peak electricity demands for air conditioning and cold winters resulting in more natural gas usage. We will apply an increasingly fine-scale understanding of the likely effects of climate change and variability to changes in energy supply and demand. Our focus will be primarily on electricity, dominated by summer cooling loads.

* *Southern California Water Planning.* Local rainfall is insufficient to sustain the huge urban populations in southern CA, and water must be imported from elsewhere through the most extensive aqueduct system in the world. The San Diego County Water Authority (SDCWA) supplies 75-95 % of water for the San Diego area (all of it imported from outside the county), and has concerns about meeting obligations to provide water for a growing population, given its dependence on imports, and its place at the "end of the pipeline." Working with SDCWA, CNAP will assess how impacts of future climate affect their forecasts and plans, particularly regarding water demand.

* *Water Resources in Nevada and Great Basin, including drought issues* The expressions of drought in NV and CA are often very different. Drought in the GB is the most poorly observed in the US. Drought in CA is well observed in the Sierra but very complicated when aggregated across the state. Drought description and depiction is notoriously difficult in managed systems, or in mixed managed-natural systems, and is part of an ongoing discussion with respect to the US Drought Monitor. CNAP will continue to examine and diagnose historical droughts in CA and NV through an analysis of a range of drought indicators.. This work will diagnose atmospheric circulation, hydrological, and water user patterns. Because drought affects the two states differently, drought decisions in CA and NV are approached differently. In conjunction with other projects, methods to survey and query drought managers to better understand these differences and their implications are being established.

* *Climate and floods* Though relatively rare, narrow, energetic, quasi-stationary moisture plumes of subtropical origin referred to as "atmospheric rivers" (a few per year) are the major flood producing mechanism in CA, Oregon and Washington, and can also "make or break" a year in water supply terms (*Fig 6*). The NOAA/State of California "CALWater" field campaign in winter 2010-11 will study this topic in detail. Questions include a) are these accurately represented in global or regional climate models? b) can their interannual variability and teleconnections allow improved seasonal and interannual forecasts? c) will climate change lead to changes in properties of atmospheric rivers? and d) what are the effects and extent of penetration of such plumes east of the Sierra Nevada and Cascades into the Great Basin?

Research summary. To conclude, we depict our rationale for the CNAP suite of research activities in terms of whether the choice of each topic is primarily motivated by “user pull” or “provider push”. Red dot size is proportional to strength of indicated influence. Blue dots indicate geographic location of primary emphasis. “West” indicates cross-RISA effort and benefit.

Assessment Services Activities for FY10-11

CNAP plans to conduct three climate assessment information workshops for California and Nevada Wildfire and Natural Resources and another set of workshops to assess coastal stakeholder issues. The resource workshops will consider wildfire as a central theme, but will also include water resources. They will engage users to understand downscaling needs and to provide information on existing downscaling capabilities. The survey for downscaling needs will be shaped in collaboration with the Oregon RISA. The intent is to initiate a dialogue with a new and growing set of decision makers who will collaborate in an ongoing regional and national climate service, addressing the question “What kinds of scientific research (physical, social, natural, etc) are required to assess the costs and benefits of alternative adaptation and mitigation options?”. As part of the results, a database will be prepared to characterize the stakeholders, their capacity to use climate information, their needs and their evolving network(s).

A set of coastal climate impacts investigations will be conducted in collaboration with Dr. Monique Myers of California Sea Grant, to identify climate change/variability research needs and potential collaborators for work on California coastal and marine environments. This project will build on the recently completed West Coast Regional Marine Research and Information project that California Sea Grant worked on in collaboration with Oregon, Washington and USC Sea Grant programs. To inform the project we also will draw from the extensive knowledge of the Sea Grant Extension Advisors, who work closely with coastal and marine stakeholders and have considerable insight into the various communities’ needs, as well as access to stakeholders. We will interface with the Southern California and Central and Northern California Coastal Ocean Observing System (SCOOS and CeNCOOS who have developed a vibrant set of coastal users. Interviews, surveys and/or focus groups will be held in both northern and southern California. As part of the results, a stakeholder database will be prepared to characterize the stakeholders, their capacity to use climate information, their needs and their evolving network(s). Results will be used to guide future CNAP coastal and marine research and collaborations, and also offered to other RISA centers having coastal stakeholders.

A cross-RISA project aims to anticipate National Assessment needs, by assessing regional adaptation capabilities and cataloging existing adaptation and adaptive management efforts in the Colorado River Basin (CRB). Nevada and especially California water management should participate, because the two states draw

		<i>Pull</i>	<i>Push</i>	<i>CA</i>	<i>NV</i>	<i>West</i>
3.3.1	A. Clim Var/Chge Impacts	•	•	•	•	•
	B. Stakeholder Interact	•	•	•	•	•
	C. Coastal Mgmt and Info	•	•	•		•
	D. Rgnl Hydroclim	•	•	•	•	•
	E. Role of Obs and Monitoring	•	•	•	•	•
	F. Coastal Clouds and Effects	•	•	•		•
3.3.2	A. Climate and Fire	•	•	•	•	•
	B. San Fran Bay/Delta	•	•	•		
	C. Energy/Water	•	•	•	•	•
	D. Clim/Wx Extr & Health	•	•	•	•	•
3.3.3	A. Water Demand	•	•	•	•	
	B. Drought Vulnerability	•	•	•	•	•
	C. Climate and Floods	•	•	•	•	•
	D. Water Res, Gt Basin	•	•	•	•	•

important parts of their water supplies from the Colorado. In collaboration with the Western Water Assessment and CLIMAS, we will convene a workshop of key stakeholders in the CRB, to (a) foster communication of the extent of existing and planned adaptation and adaptive management initiatives related to climate variability and change, (b) catalogue projects, documents, and alliances whose work, expertise, and connections can be leveraged to develop sustained and ongoing assessment, (c) evaluate the scientific capacity within the region to address climate change adaptation issues and to leverage existing federal labs, data centers, and new climate services initiatives (NOAA, DOI), and (d) assess science, decision-making, and communication needs in the region – in order to foster sustained assessment, adaptation planning and implementation. Follow-up from the workshop will include webinars, designed to maintain communication, invite new participants, and to give an opportunity for networking. These results will be linked to the CA/NV workshops described above. The outcomes will include (1) a report that summarizes needs (science, communication, climate literacy), capacity (science, existing alliances, organizations, key opinion leaders), and projects (existing and planned), and (2) development of a core group for ongoing activities, such as the webinar series.

Long-range Planning Decisions that CNAP Supports

- * *California Adaptation Planning* CNAP, with much leveraging from the California Energy Commission, has already performed two California Climate Assessments, and is in the midst of a new study of vulnerability to climate change in the State with the objective to provide improved information for adaptation. The results of this effort will be provided to the State Climate Action Team who are linked to key state agencies that are developing policies for climate adaptation.
- * *CALFED process* CNAP will continue participation in the CALFED Bay-Delta Restoration Program, a multi-decade, multi-billion-dollar effort to negotiate and implement long-term comprehensive actions to restore ecological health and improve water management in the San Francisco Bay/Sacramento-San Joaquin Delta, the largest estuary on the West Coast and a vital hub in California's water system.
- * *Wildfire information* CNAP members have established strong links to federal and state fire management agencies, have helped establish and participate in the annual National Seasonal Fire Workshops to develop a widely-referenced national outlook for the fire season, produce an experimental wildfire forecast for the western U.S., are projecting wildfire activity under possible climate changes, and are working with USFS to evaluate climate impacts on wildfire prevention costs and losses.
- * *Central Valley flood protection* CNAP members are working with California Department of Water Resources and other agency representatives to include climatic and climate change information in the State's new Central Valley Flood Protection Plan.
- * *Climate influences on sea level rise* CNAP will participate in California and San Francisco Bay vulnerability and adaptation studies and planning meetings to bring better information to California government and other stakeholders on sea level rise, which is a crucial issue to the open coast and to the San Francisco Bay Delta.

Most Common Local Decisions that Scale Up to Regional Significance

- * *Ground water withdrawal* CA's 20,000 mi² Central Valley relies heavily on a mix of surface-water diversions and ground-water pumping. The Central Valley in California contains one-sixth of the nation's irrigated land, accounts for one-fifth of the nation's ground water pumping from its aquifers, and one of the most productive agricultural regions in the world, with a value of about \$17B annually from 250 different crops. Because pumpage and diversions are not routinely monitored, there is a longstanding need to use regional hydrologic models to assess potential effects from proposed changes in water-resource management policies and proposed capital improvements in the Central Valley.
- * *Electrical energy demand* Heat waves have an important impact on the California and western inter-tied electrical system because of the increased load on the system resulting from air conditioning and other indoor appliances during hot summer spells.
- * *Voter decisions and political context.* The Schwarzenegger (California governor 2003-2010) administration has adopted a progressive agenda on the climate change problem and associated mitigation and adaptation measures. The voters will be weighing in on this agenda, directly and indirectly, this November. At a number of levels up to and including governorship, voters will be choosing between candidates who, among many other factors, are likely to differ on the climate issue. The voters will also determine the fate of environmentally-relevant legislation and ballot propositions; in particular, a proposition that would severely limit implementation of California's AB32 emissions regulation legislation has been placed on the ballot and voters will decide directly much of the immediate fate of the State's planned mitigation efforts. Thus the political context of climate-change mitigation and adaptation rests to a very large extent in the hands of California voters this fall.