Integrating Climate into Water

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Current drought conditions are beginning to raise the possibility of water shortages and perhaps even contests over the allocation of scarce supplies. Surface water supplies and precipitation-responsive groundwater resources are most sensitive to the current drought, but even systems relying on fossil groundwater may be affected when demand outstrips productive capacity.

(Above) Under the rotating boom rainfall simulator he operates, hydraulic engineer Gary Frasier gathers information on soil infiltration and water runoff. (Right) Soil core samples are withdrawn from a field near Fort Collins, Colorado, by technician Mike Murphy and soil scientist Laj Ahuja. Photo credit Scott Bauer, U.S. Department of Agriculture.

Over the past fifty years and more, engineering and policy innovations have resulted in infrastructural and institutional mechanisms specifically designed to cushion the effects of water shortages. Nowhere is this more apparent than in the management of the Colorado River (see Carter and Morehouse 2002). Yet, while the intent has been to anticipate the effects of climate-induced water shortages, only a narrow range of climate information has been used to design physical structures and institutional frameworks. Advances over the past two decades in the capacity to model and predict climate conditions – at spatial scales ranging from global to subregional and temporal scales from monthly to interannual and decadal – offer opportunities for scientists and policy makers to foresee potential water scarcity much farther in advance. The University of Arizona's Climate Assessment for the Southwest (CLIMAS) project, funded by the National Oceanic and Atmospheric Administration (NOAA) through its

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Regional Integrated Science and Assessment (RISA) program, provides a focus for innovative research into climate and its impacts in the U.S. Southwest and adjacent Mexican border region.

Climate Forecasts Affecting Policy

Many examples may be found where climate information has the potential to improve current policy designs and implementation. For example, New Mexico has a well-developed plan that outlines policies and steps to be taken in the event of drought conditions. On a larger scale, the Law of the River* specifies rules for allocation of Colorado River water in times of both surplus and shortage. One of the most recent examples of an institutional mechanism with strong climate connections is a joint resolution, formulated by the governors of the Colorado River Basin states and approved by the States of California and Arizona, to wean California's Metropolitan Water District (MWD) off its use of Colorado River water in excess of its legal entitlement of 4.4 million acre-feet (maf). The agreement specifically targets reductions in agricultural water use. In essence, the resolution calls for the adoption of interim surplus guidelines to be followed by both Arizona and California from January 1, 2002 to December 31, 2016. Much of the detail in the guidelines relates to how each state would act in the event of shortages or surpluses on the Colorado River during, and even after, the 15-year interim period. Water shortages are of particular concern to water managers and users alike.

The definition of a "shortage" year under the interim guidelines is the same as that articulated in the operating criteria associated with the 1968 Colorado River Basin Project Act and with Arizona v. California, the landmark Supreme Court decision that attempted to settle longstanding disputes between the two states over their respective allocations of Colorado River water. Thus, a shortage year is any year when the Secretary of the Interior determines that insufficient water is available to satisfy the 7.5 million acre feet of consumptive use allocated collectively to California, Nevada and Arizona. During years of officially declared shortage, the MWD is barred from ordering water in excess of the 4.4 maf allotment. Furthermore, if a shortage is declared after the Secretary has released "surplus" water to MWD and that shortage causes deliveries to Arizona to be reduced, MWD must compensate Arizona for the impacts of the shortage. There is also a provision that, in times of shortage, MWD and the Arizona Department of Water Resources (ADWR) may agree to share the impacts. For example, in the case of a multi-year shortage, ADWR may allow MWD to spread its reparation over more than one year.

There are many other provisions in this complex resolution, but the above examples indicate that climate forecasts, judiciously supplied and used, could prove valuable in anticipating and preparing for the implementation of the contingency arrangements. However, there is no

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** The Law of the River is an umbrella term for the collection of laws, treaties, court decisions, etc. that govern the allocation of waters of the Colorado River. See www.lc.usbr.gov/g1000/lawofrvr.html*

Upcoming Drought-El Niño Forecast Initiative

Will the incipient El Nino forming in the eastern Pacific Ocean break the drought plaguing the U.S. Southwest and northern Mexico? It is still too early to make a prediction. But it's not too early to begin thinking about how drought conditions and El Nino weather patterns might interact over the coming year. Beginning this August, CLIMAS is embarking on an intensive project to provide monthly forecast information to a selected group of stakeholders from New Mexico and Arizona, and potentially from northern Sonora, Mexico as well. The goal is two-fold: to test alternative ways of presenting and delivering complex climate information, and to determine how access to such information affects decision making in key areas such as water resource management, ranching and agriculture, natural resource management, energy provision, and fire management. Participants will receive monthly releases of materials, including analyses of previous periods characterized by similar climatic conditions, forecasts for time periods ranging from a month to a year in the future, forecast commentaries, and information on forecast skill levels. The project, which is being funded through the National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Science and Assessment (RISA) program, involves researchers at the University of Arizona, as well as scientists at the NOAA Climate Diagnostics Center, NOAA Climate Prediction Center, Western Regional Climate Prediction Center, and Drought Mitigation Center.

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provision in the guidelines for when, or how, climate information and forecasts should be incorporated into the process. Worldwide research on the integration of climate information into decision-making processes indicates that concerns about the professional risks associated with making decisions outside the expected norms, policy constraints, and institutional inertia can all pose significant obstacles to changing "business as usual" practices (see, e.g., Lach and Ingram 2000, Lemos et al. 2000; for a broader discussion, see Stern and Easterling 1999). Nevertheless, research also indicates that extreme circumstances can effect changes quite rapidly. In the case of water resource management, multiple stresses associated with prolonged hydrologic drought, such as public pressure for action, legal and regulatory pressures, ecological impacts, and physical changes such as ground subsidence, may all converge to motivate change – including a greater willingness to consult climate forecasts, information on the track record of forecasts (Hartmann et al. 2002), and scientific information about climatic processes and past climatic conditions in the region (see, e.g., Sheppard et al. 1999).

Opportunities for Climate Information

Among the information sources that hold potential for facilitating the implementation of the interim guidelines are seasonal and annual climate forecasts, related snowpack assessments and hydrologic forecasts, and information about times in the past when similar combinations of climatic conditions occurred and how those conditions played out. These kinds of information could prove useful to legal and interstate water management experts associated with the Arizona Department of Water Resources and Metropolitan Water District, the Secretary of the Interior, and the Bureau of Reclamation staff responsible for operations along the Colorado River. Initiatives such as the one described in the accompanying sidebar (page 17) hold potential for encouraging the integration of climate information and forecasts into interstate decision-making processes. An initiative currently underway within NOAA to create a climate services operation that would complement the services provided by National Weather Service offices aims to facilitate the dissemination of such information (for an inquiry into the value of offering climate services, see National Academy of Sciences 2001).

At finer scales, increased hiring of climatologists and hydroclimatologists by water management agencies could go a long way toward assuring institutionalization of the use of climate information over the long term. Such staffing enhancements would not only diminish risks associated with not identifying incipient drought issues early enough, but would also enhance opportunities for detecting and taking advantage of situations when unusually large surpluses might be on the horizon. For both states, the stakes are high and the opportunities for increasing resilience through use of state-of-the-art scientific information, in the face of climate variability and change, are significant.

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