

POSTER SESSION ABSTRACTS

The poster session will be held from 4:00 to 6:00 pm on Wednesday, June 11 in “the pit” (i.e., the southwestern corner of the Fleming Law Building). It will coincide with the conference reception, sponsored by Hydrosphere Resource Consultants, Inc.

WATER MANAGEMENT IN PRIOR APPROPRIATION STATES UNDER CLIMATE CHANGE

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Irrigated agriculture is the largest water user in the Western U.S. Irrigation diversions have a strong influence on streamflow in a watershed due to the complex pattern of water rights calls, diversions, aquifer recharge beneath irrigated fields, and ground water return flow to the stream. Results from global general circulation models (GCMs) were used to evaluate the effect of climate change on the pattern of stream flow and water rights diversions in the Boulder Creek watershed in northeast Colorado. A module was developed for the flow model MODFLOW that dynamically determines stream flow, diversions and return flow under the prior appropriation system. This model was used to compare existing water rights diversions to the diversion patterns under wet and dry end-member climate change conditions. Model results indicate that the diversion quantity, the number of diversions and the seniority of diversions changed significantly under both climate change scenarios compared to existing conditions. This suggests the need for new water management tools and strategies to reduce future impacts to existing water rights.

CUSTOMIZED ON-LINE CLIMATE FORECAST EVALUATIONS: A TOOL FOR IMPROVING NATURAL RESOURCES MANAGEMENT UNDER CLIMATE UNCERTAINTY

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Extensive interactions with water and land managers have revealed that decision makers have varying perspectives about climatic variability and opportunities for using climate forecasts to inform resource management decisions. In many cases, uncertainty about the accuracy of climate forecasts presents a formidable barrier to more effective use of forecast products. In addition, improper interpretation of climate forecasts can impede effective use of even the highest quality forecasts. In response, we developed a forecast evaluation framework that provides consistency

in assessing different forecast products, in ways that allow individuals to use results at the level they are capable of understanding, while offering opportunity for shifting to more sophisticated criteria. We have incorporated the framework in an on-line forecast evaluation tool that users can customize to consider the regions, lead times, seasons, and criteria relevant to their specific decision making situations. Feedback from decision makers has confirmed the appropriateness of framework components.

THE ARKANSAS RIVER WATER BANK PILOT PROGRAM: PROGRESS SO FAR

Charles Howe, Ph.D., Professor Emeritus, Economics, and Senior Research Staff, Program On Environment and Behavior, Institute of Behavioral Science, University of Colorado and Western Water Assessment; and John Wiener, J.D., Ph.D., Research Associate, Program On Environment and Behavior, Institute of Behavioral Science, University of Colorado, and Western Water Assessment.

A variety of institutional mechanisms can be used to facilitate temporary water transfers during drought conditions. Among these approaches are water banks, interruptible supply contracts, and dry-year options. In Colorado, the expanded use of water banks is under active consideration. The first region in the state to attempt a large-scale water bank is in the Arkansas River Basin. The use of the water bank during the drought of 2002 is presented to show the water management structures and the lack of water to trade. The main objections to the new water management institution are also described.

NEW MEXICO RIO GRANDE WATER OPERATIONS MODELING: CREATING A SYNTHETIC FLOW SEQUENCE REPRESENTATIVE OF REGIONAL PALEO-HYDROLOGY FOR ALTERNATIVES ANALYSIS

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A planning model version of the Upper Rio Grande Water Operations Model (URGWOM) is currently in development for use in analysis of water operations alternatives as part of an EIS being conducted under NEPA guidelines. One of the key issues in the model development has been determining how to use available data to drive the model while simulating “representative” average, drought and wet-period events. S.S. Papadopulos & Associates was asked to create a “typical” 40-year sequence, representative of a broad range of climatic conditions, to represent hydrologic inputs for the URGWOM planning model. The “pool” of available data for construction of this sequence is restricted to the period from 1975 to 1999. Our findings indicate 45% of the years between 1975 and 1999 represent “very wet” conditions for the Middle Rio Grande valley, and the Pacific Decadal Oscillation appears to significantly impact regional hydrology. Tree ring climate reconstructions were used to “normalize” the recent record to the long-term record and to determine the relative proportions and lengths of drought, average and wet conditions.

POSSIBLE EFFECTS OF PROJECTED CLIMATE CHANGE ON ECOSYSTEM AND HYDROLOGIC PROPERTIES IN THE BIG THOMPSON WATERSHED, COLORADO

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We investigated the possible effects of climate change on hydrological and ecological systems in the 35,500 hectare Big Thompson Watershed using the Regional Hydro-Ecological Systems Simulation (RHESSys) and scenarios from the Hadley and Canadian Centre for Climate Modeling (CCC) General Circulation Models (GCMs). RHESSys simulations using climate warming scenarios for this high elevation mountain watershed show a 1 to 6 week shift earlier in the timing of snowmelt and the onset of summertime low streamflow, but not large differences in annual stream discharge. Warming scenarios result in little change in simulated basin-wide annual net primary productivity (NPP), but lead to significant changes in the seasonality of NPP. Climate change leads to significant increases in tundra NPP. Climate warming scenarios that predict no increase in precipitation (CCC scenarios) result in winter snowpacks half as large as those modeled under current conditions.

THE TREEFLOW PROJECT: APPLYING TREE-RING DATA TO SUSTAINABLE WATER MANAGEMENT

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Sustainable water management in the West requires knowledge of the natural variability in water supply over time, to plan for possible future conditions. The main if not sole basis for this knowledge has been gaged records of streamflow, which are at most 100 years long—too short to capture the full range of that variability. Reconstructions of streamflow derived from the ring-widths of moisture-sensitive trees, however, span 300 years or more and are thus more fully describe the natural variability in water supply, including extreme low-flow events of most concern to water managers. In the *TreeFlow* project, we are partnering with water management agencies to develop high-quality reconstructions of streamflow in several Colorado river basins based on our extensive network of ring-width chronologies. While this approach cannot predict future droughts, it can help water managers incorporate into their planning and operations the resilience necessary to sustain water supplies during those events.

WWW-BASED CLIMATE INFORMATION AND PRODUCTS FOR WATER RESOURCE MANAGEMENT

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A representative set of web resources will be showcased that will illustrate available climate information for water policy-makers. These resources include climatologies, historic data, current conditions, forecasts (short-term and longterm) and historic climate relationships for variables such as streamflow, snow-pack, temperature, and precipitation. Some pages allow a great amount of interactivity in what is accessible and how the results are displayed. Some even allow non-scientists to "research" relevant climate/water relationships (e.g., the link between the current state of ENSO and a particular climate variable a few months later). Websites featured include those from the NOAA River Forecast Centers, the NOAA Climate Diagnostics Center, Climate Prediction Center and Climate Data Center, the National Research Conservation Service, the National Snow and Ice Data Center and many others. The URL for the complete set of webpages can be found at <http://www.cdc.noaa.gov/ClimateInfo/>, which is linked to the Western Water Assessment webpage at <http://sciencepolicy.colorado.edu/wwa/>.

USE AND EFFECTIVENESS OF MUNICIPAL WATER RESTRICTIONS DURING DROUGHT IN COLORADO

Roberta (Bobbie) Klein, Managing Director, Center for Science and Technology Policy Research, University of Colorado; and Doug Kenney, Research Associate, Natural Resources Law Center, University of Colorado. Both authors are members of the Western Water Assessment.

Drought conditions in summer of 2002 prompted several cities along Colorado's Front Range to enact restrictions on outdoor water use, focusing primarily on limiting the frequency of lawn watering. The diverse approaches utilized by 8 water providers were tracked to determine the level of water savings achieved, measured as a comparison of 2002 usage to 2000/2001 average usage, and also based on a statistical estimate of 2002 "expected use" that accounts for the impact of drought conditions on demand. Mandatory restrictions were shown to be an effective tool for drought coping. During periods of mandatory restrictions, savings measured in expected use per capita ranged from 18 to 56 percent, compared to just 4 to 12 percent savings during periods of voluntary restrictions. As anticipated, providers with the most stringent restrictions achieved the greatest savings.