Less Rain in the Forecast?

Tailored climate data may help water managers be prepared

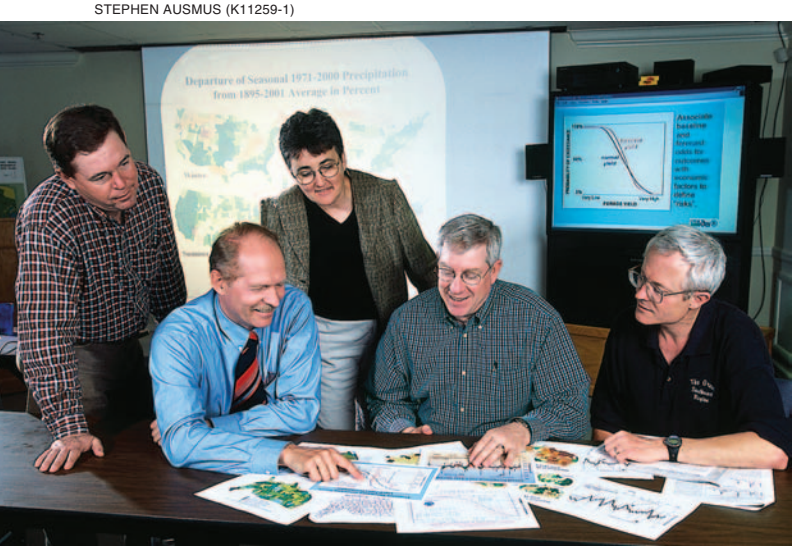
If you live east of the Rockies and think it rained more than usual at the end of the 20th century, you're probably right.

"Most of the country was wetter from 1971 through 2000 than it was during most of the 20th century," says soil scientist Jean Steiner, at ARS's Great Plains Agroclimate and Natural Resources Unit. "But it's been drier in recent years, particularly in the West. If that indicates the start of a new trend, significant challenges lie ahead for U.S. agricultural producers."

Steiner and colleagues in the unit—part of ARS's Grazinglands Research Laboratory at El Reno, Oklahoma—have taken a cutting-edge approach to studying precipitation patterns over the continental United States. They're emphasizing how improved and tailored climatic information and seasonal forecasts can help water-resource managers.

Steiner believes that the ample water from the wet spell may have many of us a bit, well, spoiled. "All that precipitation has, for the most part, been a great thing," she says. "But people may start thinking that this is normal. When drier conditions return, water supply systems will become increasingly stressed, causing conflicts about how water will be used."

STEPHEN AUSMUS (K11259-1)



Producers and scientists review the expected impact of the seasonal climate forecast on forage production potential and discuss grazing options and opportunities. Left to right: producer Mark Smith, hydrologist Jurgen Garbrecht, research leader Jean Steiner, producer and banker Allen Miller, and hydrologist Mike Van Liew.

Steiner says that such a change would introduce uncertainty in long-range planning for water resources. "It's why new management strategies that account for precipitation variations—and use the latest technologies—should be developed and put in place."

Planning for Less

The El Reno scientists are examining how high-tech seasonal forecasts and precipitation-trend data can be better used to gauge long-term effects on streamflow and water supplies.

In studying long-range precipitation variability and its impact on streamflow, hydraulic engineer Jurgen Garbrecht and meteorologist Jeanne Schneider examined National Oceanic and Atmospheric Administration (NOAA) records dating back to the late 19th century. They found that precipitation over the entire United States from 1971 to 2000 was about 4 percent higher than from 1895 to 2001. In some regions, such as the northern Great Plains, it was even wetter. "This confirms that, for at least the last three decades of the 20th century, water supply systems were operating under favorable conditions, leaving users to expect high water availability," says Garbrecht.

Meanwhile, hydrologist Michael W. Van Liew is applying hydrologic models to better predict streamflow response to rainfall. "These improved models will be great tools for effectively managing reservoir storage," he says. His exploratory work—conducted in the Little Washita Experimental Watershed in southwestern Oklahoma—dramatically illustrated an effect of excess precipitation.

"We studied streamflow during fall months that received more rainfall than average," says Van Liew. "When precipitation was 20 percent greater than average, streamflow increased by 39 percent; but when precipitation was 40 percent greater than average, streamflow increased by 96 percent."

Van Liew says this phenomenon, which he attributes mostly to increased runoff due to ground saturation, may instill a false sense of comfort regarding water supplies. "These streamflow volumes, which many communities may have grown accustomed to or even dependent on, will not be there when drier rainfall patterns assert themselves again," he says. "But this knowledge can be put into models to frame forecasts that can help reservoir managers meet water demands and anticipate when or whether streamflow will refill reservoirs."

Schneider says there's great promise in integrating dependable, long-term precipitation forecasts into water-resources decisionmaking. "We need to find out how seasonal precipitation forecasts might affect the underlying land and streams," she says. "We can do this by modeling soil moisture and streamflow response for a range of historical and forecasted conditions."

Her team has examined the usefulness, dependability, and effectiveness of the experimental long-term precipitation

forecasts issued monthly by NOAA's Climate Prediction Center. "We found that in the desert Southwest, California, the Pacific Northwest, and along the Gulf and southern Atlantic coasts, the forecasts have offered some dependable predictions of departures from normal conditions," Schneider says, "but they had little utility in other areas of the country."

A Glimpse Into the Future

Hydrologist John X. Zhang is relating this research directly to agriculture. He's using seasonal climate forecasts and climate-change projections to measure the effects of short- and long-range variations on water runoff, soil erosion, and winter wheat production.

"If we translate seasonal climate forecasts to a range of possible agricultural outcomes, farmers and ranchers will be able to make better management decisions," he says. "To test this theory, we're showing the potential effects of climate change—well into the future—on soil erosion and winter wheat productivity in central Oklahoma."

Zhang took actual changes in precipitation and temperatures between 1950 and 1999 and those projected for 2056 to 2085 and incorporated them into a climate generator. He then constructed five climate-change scenarios.

"The scenarios offer a glimpse of how soil erosion and crop production may change if various climate factors change," says Zhang. "For instance, an increase in atmospheric CO_2 concentration of 50 percent increased wheat yield dramatically, but an increase in temperature along with increased CO_2 considerably decreased this yield and increased soil loss.

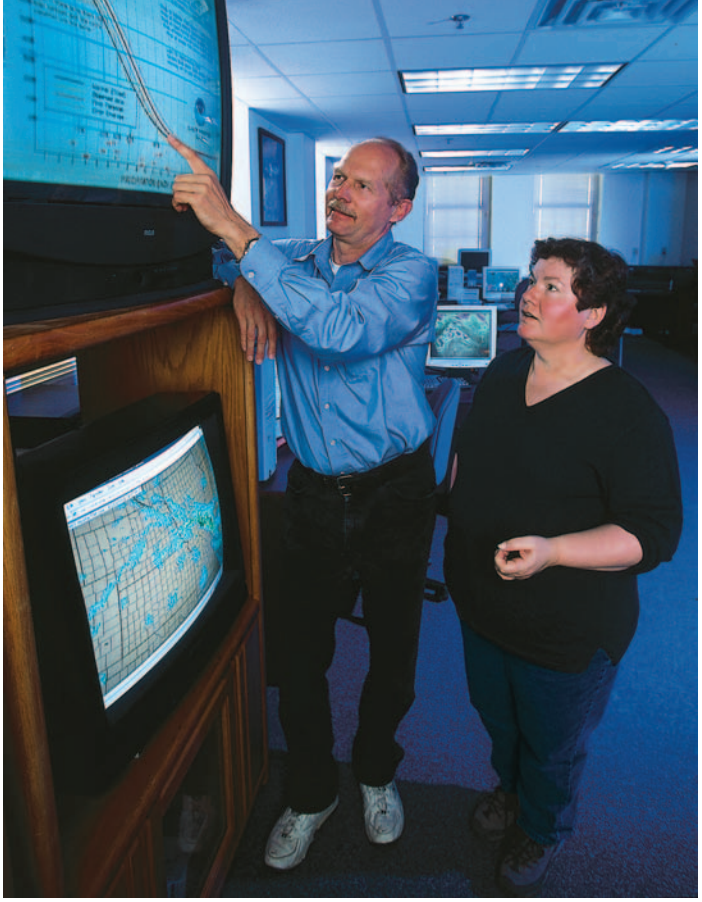
"Overall results indicate that conservation tillage and no-till systems would be effective in controlling soil erosion in the region under the climate change projected in these scenarios."

Steiner says that while seasonal climate forecasts and information on precipitation trends are already old news to the National Weather Service, changes are needed in how the information is analyzed and presented so that agricultural producers can reap the full benefits of this knowledge.

"We've taken some steps toward closing this gap," she says. "Tailoring our planning and management tools to include known variations of precipitation and seasonal forecasts will lead to better agricultural production, higher profitability, better conservation, and, ultimately, more reliable estimates of water quantity and quality for all."—By **Luis Pons,** ARS.

This research is part of Water Quality and Management (#201) and Global Change (#204), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

Jean L. Steiner is at the USDA-ARS Grazinglands Research Laboratory, 7207 W. Cheyenne St., El Reno, OK 73036; phone (405) 262-5291, fax (405) 262-0133, e-mail jsteiner@grl.ars.usda.gov. ★



STEPHEN AUSMUS (K11261-1)

Hydrology engineer Jurgen Garbrecht and meteorologist Jeanne Schneider interpret the latest seasonal climate forecast issued by NOAA's Climate Prediction Center.

STEPHEN AUSMUS (K11260-1)

Curious livestock watch as technician Pat King and meteorologist Jeanne Schneider perform a soil core extraction to check soil moisture following a drought.