Urban Effect May Increase Phoenix Precipitation

Results of a study published in the *Journal of Arid Environments* suggest that the Phoenix area has experienced statistically significant mean annual precipitation increases of 12 to 14 percent due to urbanization. The author of the investigation, J.M. Shepherd of the University of Georgia, used a 108-year precipitation record, global climate observations, and satellite data to look for anomalies in monsoonal rainfall around two arid cities that have experienced recent periods of rapid growth: Phoenix and Riyadh, Saudi Arabia.

The Phoenix study used 4-kilometer resolution precipitation data for about 12,600 stations in and surrounding the city, obtained from the Spatial Climate Analysis Service at Oregon State University. In addition, data from the Tropical Rainfall Measuring Mission (TRMM) were used to study mean rainfall rates in central Arizona during the extreme drought of 2003 in order to try to detect the same anomaly under relatively homogeneous drought conditions.

The increase in Phoenix precipitation was observed from the "pre-urban" period of 1895 to 1949 to the "post-urban" period of 1950 to 2003, and occurred in the northeastern suburbs and exurbs of the Phoenix metropolitan area, in the lower Verde River basin. The anomaly also occurred during the 2003 drought. It "cannot simply be attributed to maximum topographic relief and is hypothesized to be related to urban-topographic interactions and possibly irrigation moisture," said the article.

Riyadh has also experienced increases in temperature and precipitation in the last 10 to 15 years, but the precipitation increase could not for certain be attributed to urbanization because other, less urbanized areas in the country showed similar increases.

Shepherd plans to continue this research through the use of "coupled atmosphere-land surface models to test the hypothesis that urban-topographic dynamics and increased moisture from irrigation practices alter precipitation in arid regimes." He also noted that the role of aerosols must be considered in future research.

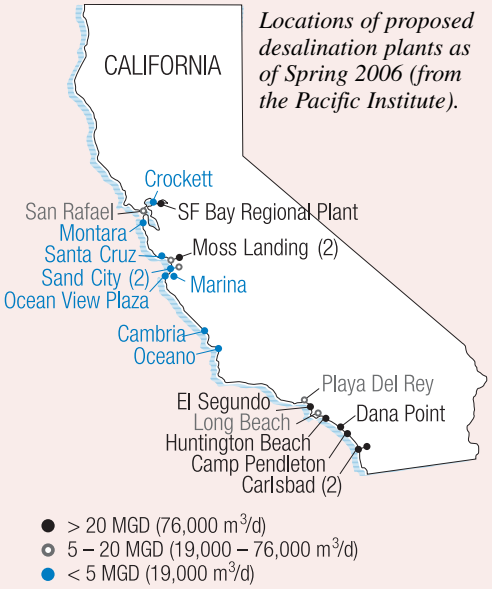
The complete article is "Evidence of urban-induced precipitation variability in arid climate regimes," by J.M. Shepherd, published in the Journal of Arid Environments, *first available online May 24, 2006.*

Report: CA Desal is Premature

from the Pacific Institute

Having completed a year-long California-focused analysis of desalination, the Oakland, California-based Pacific Institute concludes that most of the state's seawater desalination proposals are premature.

According to its report, "Desalination, With a Grain of Salt," most if not all of the 21 desalination projects proposed in California fail to adequately address economic realities, environmental concerns, or potential social impacts. Recent gains in desalination efficiency are being offset by rising interest rates and increases in energy and construction costs. Even the cheapest estimates exceed the costs of conservation and efficiency improvements, fixing leaks, and other sources of new supply. As a result, desalination remains an extremely expensive source of fresh water for Californians.



Locations of proposed desalination plants as of Spring 2006 (from the Pacific Institute).

"Desalination will be part of California's water future, but the future's not here yet," said Peter Gleick, president of the Pacific Institute. "Most California communities can find additional water, quicker and for less money, by improving efficiency and management."

Desalination is energy intensive, making its already high costs vulnerable to rising energy prices. Electricity accounts for 44 percent of the typical water costs of a reverse-osmosis plant. An energy rate increase of 25 percent increases the cost of produced water by 11 percent. Energy price uncertainty creates costs that are ultimately paid by water users, but project cost estimates often omit such considerations.

Statewide, proposals range in size from a small plant providing water for a private development in Monterey to plants in Southern California that would be among the largest in the country. The total capacity of the proposed plants could amount to approximately 450 million gallons per day, which would represent a massive 70-fold increase over current seawater desalination capacity.

In Southern California, interest in desalination is driven by concerns about drought, population growth, and the desire to reduce dependence on outside water sources. Concerns about drought, water supply limitations, overuse of water needed for ecosystems, and growth moratoriums are driving Central California's projects. The purposes of the four proposed plants in Northern California range from improved reliability during droughts and emergencies to meeting anticipated growth needs and providing environmental benefits.

"While desalination can produce high-quality, reliable water, it can also have significant impacts on marine ecosystems," said Gleick. Marine organisms can be crushed against intake-pipe screens or sucked in and killed by the desalination process. Further, the discharge of the highly

salty waste brine—which is sometimes laced with processing chemicals and toxic metals—can harm local fish populations and accumulate in the food chain.

The report also noted that desalination can have impacts on community development. New water sources along the coast can lead to unanticipated and unplanned growth there.

The 100-page report, "Desalination, With a Grain of Salt," is available at www.pacinst.org/reports/desalination.

New Process Degrades Estrogenic Compounds in Water

Medical News Today recently reported that a new process has been identified that breaks down two types of estrogenic compounds rapidly and in an environmentally friendly manner. According to the June 28 report, scientists from Carnegie Mellon University and the U.S. Department of Agriculture found that Fe-TAML® (tetra-amido macrocyclic ligand) activators and hydrogen peroxide together create a catalytic process that quickly and nearly completely breaks down the estrogens estradiol and ethinylestradiol in the laboratory. Fe-TAML activators are "synthetic catalysts made with elements found in nature," originating at Carnegie Mellon's Institute for Green Oxidation Chemistry.

Estrogenic compounds, which can mimic or block the actions of hormones, are increasingly being identified in surface water and groundwater, where studies have suggested they can impact the reproduction and development of fish, frogs, and other organisms. Estrogens enter the water primarily through incomplete wastewater treatment and in runoff from livestock farms.

The researchers' findings show promise as a means of destroying estrogenic compounds in wastewaters. In fact, they found that the catalytic process degraded 95 percent of ethinylestradiol, the synthetic compound most common in birth control pills and typically resistant to most biological degradation processes, within five minutes, said the article. The next phase of the study will involve field-testing the process on swine wastewater.

Visit www.medicalnewstoday.com/medicalnews.php?newsid=46029.

Sprinklers Benefit Community and Colorado River

For nearly the past century, farmers and ranchers in Ferron, Utah, have been flood irrigating. In this arid and mineral-laden region of central Utah, flood irrigation has resulted in large salt accumulations in Ferron Creek—a tributary to the San Rafael and Colorado rivers—and caused extensive damage to agricultural soils. Now, a pressurized irrigation system

continued on next page

R & D (continued)

allows water-saving sprinkler irrigation equipment to water nearly 9,000 acres of farmland. In addition, the irrigation system, funded by the U.S. Bureau of Reclamation-led Colorado River Basin Salinity Control Program (CRBSCP), has prevented nearly 30,000 tons of salt annually from entering the Colorado River.

In 1998, prior to initiation of salinity control efforts, Ferron water losses from ground transportation of water and on farm irrigation contributed to the salt accumulation in the Colorado River. The overall efficiency of flood irrigation of agricultural soils was about 30 percent.

Today, salt accumulation has been decreased by reducing deep percolation, eliminating canal and ditch seepage, and by improving efficiency of surface irrigation by installation of the pressurized sprinkler system. Efficiency has increased to 67 percent. And another benefit has been realized: a continued water supply in the fall. Prior to salinity control efforts, the water supply for farming would typically be depleted by late summer. But in 2005, irrigation water remained in the reservoirs until late November, and not all was used.

The goal of the CRBSCP is the basinwide reduction of salt mobilization and transport to the Colorado River while allowing water resources to continue to be developed. "The program is a great example of cooperative conservation at the grassroots community level," noted Roger Barton, program manager with Utah Association of Conservation Districts. "Ninety-seven percent of the farmland has replaced flood irrigation with the sprinkler irrigation."

Visit www.usbr.gov/uc/.

EPA Evaluates Wadeable Streams

The U.S. Environmental Protection Agency recently released the results of its Wadeable Streams Assessment (WSA), described as the first consistent evaluation of the streams that feed rivers, lakes, and coastal

waters in the United States. Wadeable streams are those shallow enough to be adequately sampled without a boat.

Conducted between 2000 and 2004, the study sampled 1,392 sites selected to represent the biologic condition of all streams that share similar ecological characteristics in various regions; nine such ecoregions were defined. The collaborative effort involved dozens of state environmental and natural resource agencies, federal agencies, universities, and other organizations. More than 150 field biologists were trained to collect environmental samples using a standardized method.

WSA used benthic macroinvertebrates supplemented by chemical and physical indicators to determine the biological condition of streams. Benthic macroinvertebrates include such creatures as aquatic larval stages of insects, crustaceans (crayfish), worms, and snails. Some benthic macroinvertebrates are more sensitive to pollution than others, thus data on the abundance of various types of organisms can indicate the health of a stream. Chemical indicators that were measured included phosphorus, nitrogen, salinity, and pH; physical indicators were streambed sediments, in-stream fish habitat, riparian vegetative cover, and riparian disturbance.

In the xeric ecoregion, which covers much of the West, the survey showed that 42 percent of the streams were rated "good," 15 percent "fair," and 39 percent "poor" (4 percent were not assessed), compared to a national average of 28 percent "good," 25 percent "fair," and 42 percent "poor." Category thresholds were developed separately for each ecoregion based on the condition at the best available regional reference sites. The leading causes of biologic stress in the xeric region were identified as riparian disturbance (high levels in 44 percent of stream miles), total nitrogen (high in 36 percent of stream miles), streambed sediments (32 percent having excess stream sediments), and instream fish habitat (poor in 27 percent of streams).

The WSA is part of a series of surveys to evaluate all of the nation's waters. Coastal waters have already been sampled, and during the next five years EPA will sample lakes, large rivers, and wetlands. Then the process will be repeated to provide ongoing comparisons of the state of the waters and point to possible future action.

The 117-page report is available at epa.gov/owow/streamsurvey.

New Desalination Technology Uses Evaporation

Arizona Technology Enterprises LLC (AzTE) announced last spring that Altela Inc., an Albuquerque-based desalination product and service company, acquired the rights to a low-cost water purification technology, "dewvaporation," developed at Arizona State University (ASU). Specifically, Altela acquired the exclusive worldwide license for the core intellectual property relating to the technology.

Dewvaporation was developed by ASU chemical engineering professor Jim Beckman; it removes salt from water through dew formation and evaporation. According to AzTE, the technology removes 100 percent of the dissolved salts and other contaminants from industrial wastewaters and undrinkable brackish waters found throughout the world—representing the first new low-cost water desalination technology in the last 50 years. Altela plans to incorporate the technology into its AltelaRain™ water desalination systems.

AltelaRain also evaporates water from brackish, salty waste streams, and requires only minimal amounts of low-grade heat to drive the distillation process, according to Altela's website. The system is six times more efficient than a single-pass boiler/condenser. Altela initially targeted the technology to the oil and natural gas production industry, where the large volumes of salt water coproduced with oil and natural gas currently are either reinjected into the ground or stored in large pits, incurring high disposal costs and environmental liabilities. Altela's approach converts the contaminated water into clean water that can be used onsite. The AltelaRain system has successfully completed oilfield beta testing. The acquisition of dewvaporation rights will allow Altela to expand its market to industrial wastewater, saltwater, and other water purification markets.

AzTE is ASU's technology commercialization company, working with university inventors and industry to transform scientific progress into products, services, and new companies. The group transfers technologies invented at ASU, Northern Arizona University, and their affiliated research institutes to the private sector by mining university research, pursuing patents, negotiating licenses, and forming spinout companies.

Visit www.azte.com and www.altelainc.com.

LLNL Also Developing Desal Tech: Nanotube Membranes

Not to be outdone by ASU and Altela, researchers at Lawrence Livermore National Laboratory (LLNL) and the University of California at Berkeley have created a membrane made of carbon nanotubes and silicon that may offer, among many possible applications, less expensive desalinization.

The nanotubes, molecules made of carbon atoms in a unique arrangement, are hollow and more than 50,000 times thinner than a human hair. Billions of these tubes act as the pores in the membrane. The extremely smooth inner surface of the nanotubes allows liquids and gases to rapidly flow through, while the tiny pore size blocks larger molecules.

The pores are so small that only six water molecules can fit across their diameter,

continued on next page

however "the gas and water flows that we measured are 100 to 10,000 times faster than what classical models predict," said Olgica Bakajin, the Livermore scientist who led the research. "This is like having a garden hose that can deliver as much water in the same amount of time as fire hose that is ten times larger."

The common method of desalination, reverse osmosis, uses less permeable membranes, requires large amounts of pressure, and is quite expensive. In contrast, these more permeable nanotube membranes could reduce the energy costs of desalination by up to 75 percent compared to conventional membranes used in reverse osmosis, according to a laboratory announcement.

Simulations of water transport through carbon nanotubes predict that it should flow rapidly. Water molecules should slide through either because of the "slipperiness" of the carbon nanotube surface or due to molecular ordering induced by spatial confinement. The experiments performed by the LLNL team demonstrated the predicted rapid flow, but further research is needed to determine the exact transport mechanisms.

Visit www.llnl.gov.

USGS Reports on National Assessment of VOCs

In April, the U.S. Geological Survey released a report describing the occurrence of volatile organic compounds (VOCs) in groundwater and drinking-water supply wells across the nation. The report concludes that VOCs were detected in aquifers nationwide, however they were not detected in most of the sampled wells: about 80 percent had no detections above a threshold of 0.2 part per billion. The compounds were detected in some domestic and public-supply wells, but seldom at concentrations greater than U.S. EPA regulatory or USGS health-based guidelines.

Groundwater samples from nearly 3,500 wells representing 98 aquifer studies were analyzed. Most were sampled between 1985 and 2002. The study was not designed to evaluate localized VOC contamination of groundwater, such as at landfills and leaking underground storage tanks. The report also presents a USGS analysis focused only on drinking-water supply wells, including more than 2,400 domestic and nearly 1,100 public wells.

According to senior author John Zogorski, "VOCs were detected in drinking-water supply wells—specifically, in 14 percent of domestic wells and 26 percent of public wells, but only a small number of samples (less than 2 percent) had VOC concentrations that were greater than federal drinking-water standards. Concentrations greater than standards were accounted for by eight compounds, in large part by the solvents perchloroethene (PCE) and trichloroethene (TCE), and the agricultural fumigant dibromochloropropane (DBCP)."

VOCs were detected in 90 of 98 aquifers studied. Many had VOC concentrations less than one part per billion; their prevalence at low concentrations indicates the need for continued management and monitoring of the occurrence of these contaminants over the long term.

The most frequently detected VOCs were chloroform, the solvents PCE and TCE, and methyl tert-butyl ether (MTBE). An important source of chloroform appears to be related to the recycling of water that had been chlorinated or exposed to household products containing chlorine, such as bleach. Artificial recharge of water and wastewater containing chloroform, most likely resulting from water chlorination, is an increasingly common practice, particularly in the West. MTBE has been intensively used in reformulated gasoline for only about 10 years, but its relatively high mobility and persistence has allowed it to reach groundwater. Production of PCE and TCE has been declining since the 1970s; monitoring over the long-term will help to track any changes in their concentrations in groundwater.

The report, "Volatile Organic Compounds in the Nation's Ground Water and Drinking-Water Supply Wells," USGS Circular 1292, is available at water.usgs.gov/nawqa/vocs/national_assessment/.

Texas Institute to Analyze Critical Water Issues

The Texas Water Resources Institute recently established the Office of Strategic Water Issues to provide non-biased, science-based analyses of critical water issues facing Texas, according to Allan Jones, the institute's director. The office will develop consensus recommendations and communicate them to policy and decision makers to help them make informed decisions. These objectives will be accomplished by:

- Creating an advisory committee of legislative staff, state and federal agency staff, university water resources leaders, and the private sector;
- Soliciting and responding to requests for white papers and analyses of critical and contentious water resources issues in Texas (three to six per biennium);
- Inviting experts from regulatory agencies, interest groups, and universities to analyze the issues;
- Developing consensus recommendations regarding the issues;
- Communicating with policy makers, regulators, interest groups, and the public;
- Helping secure resources needed to resolve issues and solve problems.

"We see the office as inviting experts from regulatory agencies, interest groups and universities to analyze important water issues, using the best available science and most effective policies," Jones said. "Issues could range from protecting our aquifers from overdraft and contamination or purifying and using the state's extensive brackish and saline water resources."

Visit twri.tamu.edu/projects/OfficeStrategicWaterIssues.pdf.