



The Water bLog

a newsletter of the
Utah Center for Water Resources Research
at Utah State University

Welcome!

The Water bLog is the semi-annual newsletter of the Utah Center for Water Resources Research (UCWRR), housed at the Utah Water Research Laboratory. The center supports the development of applied research related to water resources problems in Utah and promotes instructional programs that will further the training of water resource scientists and engineers. Each issue of **The Water bLog** reports on a small selection of the current or recently completed research projects conducted at the center. More information is available online at:

<http://uwrl.usu.edu/partnerships/ucwrr>

Message from the Director



Mac McKee, Director

Water is a critical resource for many aspects of our society—from agriculture to industry, and from communities to countries. Access to a reliable and safe water supply is essential to our wellbeing. Here at the Utah Center for Water Resources Research, we are developing new ways to monitor water use and forecast future water demands in order to provide better information for efficient water management. Many of these solutions can be applied to other locations throughout the state and beyond.

This edition of the **Water bLog** highlights two current projects that exemplify the broad range of research ongoing at the UCWRR. The first project is giving farmers and water managers timely information about soil and crop conditions, up to 16 days in the future, allowing more efficient use of irrigation water, while maintaining crop productivity. The second project is assessing the causes of water quality challenges in Park City, Utah, and developing methods to preserve a high quality drinking water supply for its citizens. These projects represent only a small portion of the active research ongoing at the UCWRR that is finding practical solutions to natural resources challenges throughout the state. ■

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Far Afield



RESEARCH HIGHLIGHT

Irrigation Management Looks into the Future

Researchers at the UCWRR have developed a new Crop-Water Monitoring and Information System (CWMIS) that can give farmers and water managers a glimpse to current and into the future—up to 16 days into the future, to be precise.

The past century has seen many innovations in agriculture that have improved water policy, management, distribution, and monitoring, but irrigation water delivery and on-farm management are often still based on factors such as water rights allocation, tradition, and past irrigation experience—factors not necessarily related to actual crop water use.

Farmers and managers need access to timely information about current water needs and crop conditions—or better yet, the ability to see into the future—



The CWMIS is available on the internet

to accurately predict irrigation timing and needs and manage irrigation water delivery more precisely, while improving crop productivity.

Research

Dr. Alfonso Torres-Rua and other UCWRR researchers have developed a new decision support system platform, called the Crop-Water Monitoring and Information System (CWMIS). The CWMIS integrates state-of-the-art monitoring and forecasting algorithms (based on readily available Landsat Satellite Mission data) to provide irrigated and non-irrigated agriculture with current and short-term (8 and 16 days in advance) forecasting information about crop water use and crop growing conditions at the pixel level (15 m) and aggregated to farm and irrigation system levels.

The CWMIS, which is currently implemented in Utah's Lower Sevier River Basin, provides three core performance indicators to farmers and water managers:

- ◆ Farm and Irrigation System Crop Water Use (using a spatial evapotranspiration model).
- ◆ Crop Yield (based on Leaf Area Index estimations).
- ◆ Crop Water Stress (based on surface temperature, crop vegetative cycle, and current weather conditions).

The CWMIS uses Google Maps technology to display these indicators spatially for individual farms and irrigation systems. Clicking an individual field displays a graphical report about the selected field and a comparison against the current average values within the irrigation system. The information is



CWMIS layer maps of the Lower Sevier River Basin displaying (1) current and past crop water stress (left), (2) accumulated dry crop biomass in TM/acre (upper right) and, (3) accumulated crop water use in inches (lower right)

WMISS website is available to the general public at:

<https://sites.google.com/a/aggiemail.usu.edu/lower-sevier-river>

updated every time the Landsat satellite passes over the irrigation system (8 days).

Benefits to the State

Dr. Torres-Rua has been invited to speak at the 2014 Utah Water Users Workshop in St. George, Utah, which will involve state water-users and managers, to describe the benefits of this technology. Some benefits include the following:

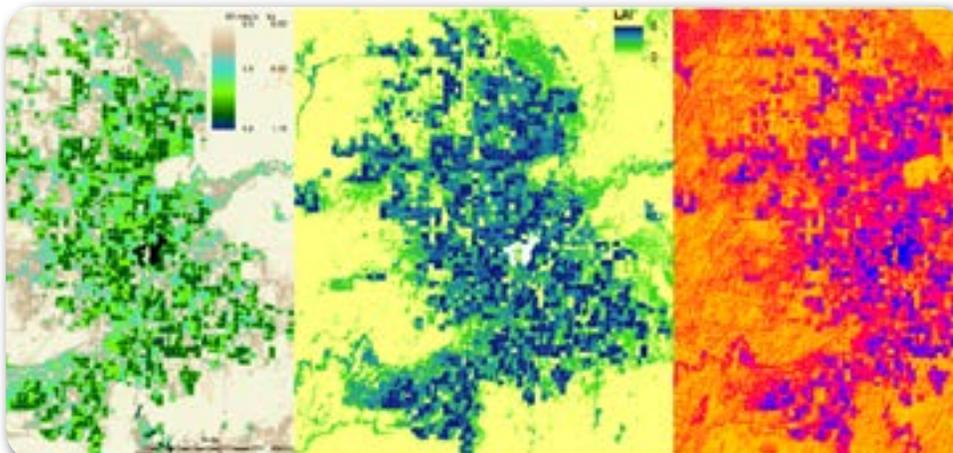
- ◆ The CWMIS provides actionable information for individual irrigators, as well as irrigation delivery system operators (for example, reservoir managers and irrigation companies).

- ◆ This completely automated technology is inexpensive and easy to implement. It can be applied to any irrigated agricultural lands in the state.
- ◆ More efficient irrigation would make more water available for other purposes (e.g., urban or industrial).

Looking to the Future

The future could bring even more useful information to irrigators and water managers as the capabilities of the CWMIS expand. The platform's modular design allows for additional crop/water performance indicators to be easily implemented using Landsat and other satellite platforms such as MODIS Terra.

Because of the large Landsat imagery archive (~40 years for any agricultural location in the world), the continuously processed geodatabase data in the CWMIS can help to create surrogate information and historical trends that can be used as a baseline for decision making and assessment in such areas as climate change impact. ■



CWMIS uses pixel-based estimations of evapotranspiration (mm/d) (left), Leaf Area Index (center), and surface temperature (right) to provide individual-farm-level actionable information

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Addressing Adverse Water Quality Episodes in Park City, Utah

Park City, Utah has experienced some troubling water quality episodes in the past several years. UCWRR researchers are looking into the causes of these events and seeking ways to maintain a consistent high-quality drinking water supply.

Park City, Utah, is famous for its ski resorts and for hosting the Sundance Film Festival. It was named “The Best Town in America” by Outside magazine in 2013. However, Park City is also becoming infamous for its drinking water quality. In 2007 and 2010, Park City experienced water quality episodes that featured discolored water with high levels of arsenic, thallium, manganese, iron, and mercury in the water distribution system.

The city has an incredibly complex water system that features a variety of water sources (including groundwater, surface water, and water passing through old mine tunnels), several treatment plants, unique water demand patterns, and a complicated water distribution system with more than 50 pressure zones.

Research

UCWRR researchers are working with Park City and Confluence Engineering to assess the causes of these adverse water quality events and develop techniques to respond to changes in the water system and preserve a high-quality water supply. Project goals include the following:

- Evaluate Park City’s historic water quality data and sample the water sources and distribution system to establish water quality patterns.
- Conduct bench-scale experiments to understand mechanisms that cause release of corrosion scale, sediments, and biofilms in the distribution system.



An array of water samples collected during an ice-pigging cleaning trial

- Conduct full-scale trials of cleaning techniques to remove scale build-up within the distribution system pipes.

Benefits to the State

This project will help Park City manage its complex water system to provide high-quality water to citizens and visitors.

In addition, the knowledge and real-time monitoring and assessment strategies developed will be applicable to many other water utilities in Utah and the US. Nearly 60 representatives of water systems throughout the State of Utah recently attended a workshop where the preliminary results from this project were presented.

Looking to the Future

The initial investment of UWRL Mineral Lease Fund money for this project has also been leveraged into a \$495,000

project sponsored by the Water Research Foundation (project lead, Confluence Engineering).

Researchers will install on-line water quality monitoring panels and compare the on-line data with the routine monitoring results. Insights gained from the bench-scale experiments and full-scale cleaning trials will be combined with monitoring results to provide optimal management of water quality. ■

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Foam swabs before and after passing through pipes



Scholarship Awards

Graduate student Morris Dimitry and undergraduate Daniel Ryan,

CEE students Morris Dimitry and Daniel Ryan

both students of UCWRR faculty member Dr. Michael McFarland, were recently awarded scholarships from the Water and Environmental Association of Utah (WEAU) taking both the graduate and undergraduate level awards.

The WEAU is the State of Utah affiliate of the Water Environment Federation, a member association of water quality professionals including "public works staff, treatment plant operators, engineers, scientists, and planners working to preserve and enhance water quality and the global water environment." ■



Faculty NSF Award

Dr. Jeffery S. Horsburgh, UCWRR faculty member, recently received a NSF award for his

Dr. Jeffery S. Horsburgh

research titled, "The Community-Driven BiG CZ Software System for Integration and Analysis of Bio and Geoscience Data in the Critical Zone." Dr. Horsburgh will collaborate with the CZ community to co-develop a web-based integration and visualization environment for joint analysis of cross-scale bio and geoscience processes in the critical zone (CZ). The software stack will be developed on public repositories as a modular suite of fully open source software projects built around a new Observations Data Model Version 2.0 (ODM2) being developed under separate NSF funding. ■

Future Issues

Research Highlights:

"Collaborative Water Workshop in Egypt" (UCWRR researcher Jagath Kaluarachchi is collaborating with US and Egyptian government and education leaders to address the future of water management in Egypt)

"Improving the Safety of Low Head Dams"

(UCWRR research Mike Johnson is identifying new ways to reduce the hazards associated with these simple hydraulic structures)

FAR AFIELD

The UCWRR welcomed two visiting professors in recent months: Dr. Seung-hee Han (Kongju National University, Korea), and Dr. Sebastien Epicum (University of Liege, Belgium). Other visitors include the College of Engineering Advisory Board, dignitaries from the Oak Ridge Associated Universities, and many water resources community representatives who attended a reception in honor of former water research visionary, Dean F. Peterson. Our faculty have also traveled far and wide conducting and presenting their research and sharing their extensive water resources expertise.

Recent Travels:

- Melbourne, Australia
- Chengdu, China
- Lyngby, Denmark**
- York, England
- Paris, France
- Koblenz, Germany
- Bari, Italy
- Kathmandu, Nepal
- Lima, Peru



Dr. William J. Doucette lectures at a week-long PhD summer course in Lyngby, Denmark

Dr. William J. Doucette, a UCWRR faculty member well known for his research into the uptake of chemicals into plants, was recently invited to lecture at the Technical University of Denmark, Department of Environmental Engineering, for a week-long PhD summer course, "Modeling of Plant Uptake and Application to Environmental Science and Engineering," organized by Dr. Stefan Trapp.

Students from Denmark, Israel, Germany, Ireland, the UK, Norway, Sweden, France, China, Turkey, the Czech Republic, Switzerland and the US were in attendance. ■

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