



# 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

**T**he UCWRR has focused on Utah's water resources challenges for over 50 years now, so we are delighted to join with Utah State University and the Utah Water Research Laboratory, our host institution, in celebrating 2015 as 'The Year of Water.' It is our mission to develop better ways to measure, manage, and deliver water, in Utah and beyond. The UCWRR conducts water resources management research "from the atmosphere to the

mountain top, from the seashore to the faucet and the field." We gather data at every level, and we conduct research to advance understanding of our hydrologic systems, to help us use water more wisely.

This issue of the Water bLog looks broadly at the scope of research conducted by UCWRR researchers, and also at a project that demonstrates how computer scientists, working with water resources experts can improve processes involved in precision agriculture.

These projects represent only a tiny fraction of the active research ongoing at the UCWRR aimed at finding practical solutions to natural resources problems throughout the state. ■

## INSIDE:

### Research Highlights:

- ▶ **USU 'Year of Water' 2015**
- ▶ **Near Real-Time Orthorectification of UAV Image Mosaic Maps**

### In the News

- ◆ **2015 Faculty and Student Awards**

### Far Afield

- ◆ **'Year of Water' Visitors**

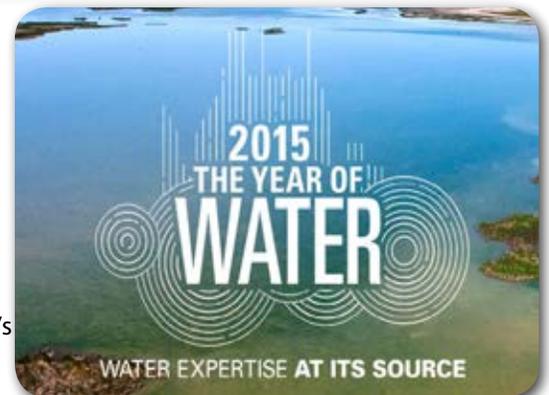


## RESEARCH HIGHLIGHT

### USU Designates 2015 'The Year of Water'

*Utah State University is celebrating all things WATER in 2015. Bringing water into the public consciousness is a good way to highlight the need to more efficiently manage this critical resource, especially in semi-arid states such as Utah*

**2015** is the 'Year of Water' at Utah State University (USU). Colleges across campus are coming together to highlight this most important of natural resources through lectures, celebrations, art exhibits, concerts, extension activities, and of course, research. As Utah's land grant institution, USU's mission from the very beginning has included a focus on Utah's water. As noted on the university's Year of Water website: ●●●



Visit USU's Year of Water website at:  
[usu.edu/yearofwater/](http://usu.edu/yearofwater/)

*"...now, 127 years later, Utah State University engineers, hydrologists, agronomists, sociologists, climate scientists and other researchers across a range of disciplines are still, as on Day 1, the foremost voices on issues related to water in the state. USU's water specialists today, in fact, are among the nation's and even the world's leading experts on many water-related issues..."*

Many of these water experts are faculty members associated with the Utah Center for Water Resources Research (UCWRR). The UCWRR was in the initial group of 14 of the total 54 Water Resources Research Centers funded by the Water Resources Research Act of 1964. Because the State of Utah had already accepted plans and appropriated funds to build the Utah Water Research Laboratory (UWRL), with ground broken in 1963, the Center was up and running under the umbrella of the UWRL when the building was completed in 1965, making it one of the first operational Centers in the nation.

During this Year of Water, we look back to celebrate our history of 50 years in the UWRL building as we also look forward to the challenges ahead. The following are just a few of the hundreds of ongoing water research projects that are benefiting Utah now and into the future.

### Research

- ◆ A study testing the components of the nitrogen cycle in Silver Creek to accurately describe the impacts



Continuous data collected at monitoring sites in Cache Valley, providing high frequency observations that are challenging the assumptions and process representations in the current suite of hydrologic models

to Utah steams from the nitrogen discharges from our wastewater treatment plants.

- ◆ A study developing a Crop and Water Monitoring and Information System to support more efficient agricultural irrigation water use.
- ◆ A gain/loss study on the severely degraded San Rafael River to support restoration of spawning habitat for native fish species.
- ◆ A project advancing the capabilities of water observing infrastructure and cyberinfrastructure for watersheds within Cache Valley, Utah to better understand hydrologic processes and inform hydrologic and water quality modeling.
- ◆ Labyrinth weir research to provide and improve spillway upgrade alternatives that may increase the

sustainability of existing dams with undersized spillways.

- ◆ A study assessing source water protection plans for potential phosphorus mining impacts in the Uintah basin.
- ◆ A study to understand salinity generation mechanisms, monitoring needs, and salinity reduction allocation tradeoffs in the Upper Colorado River Basin.
- ◆ A study investigating aquifer conditions that lead to release of arsenic to groundwater resources.

### Looking to the Future

A continued focus on water, not just during this Year of Water but well into the future, will be critical as we grapple with the challenges of increasing population, degraded water quality, and changing climate, among many others. Much will be required of Utah's decision makers in the future. The practical knowledge, scientific clarity, and improved technology that arise from the research of UCWRR faculty and students, along with other researchers at USU, will be critical to success in the years to come, making every year a 'Year of Water'. ■



In-situ benthic chambers operating at the Silver Creek field site

### Mac McKee, Ph.D.

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# Near Real-Time Orthorectification of UAV Image Mosaic Maps

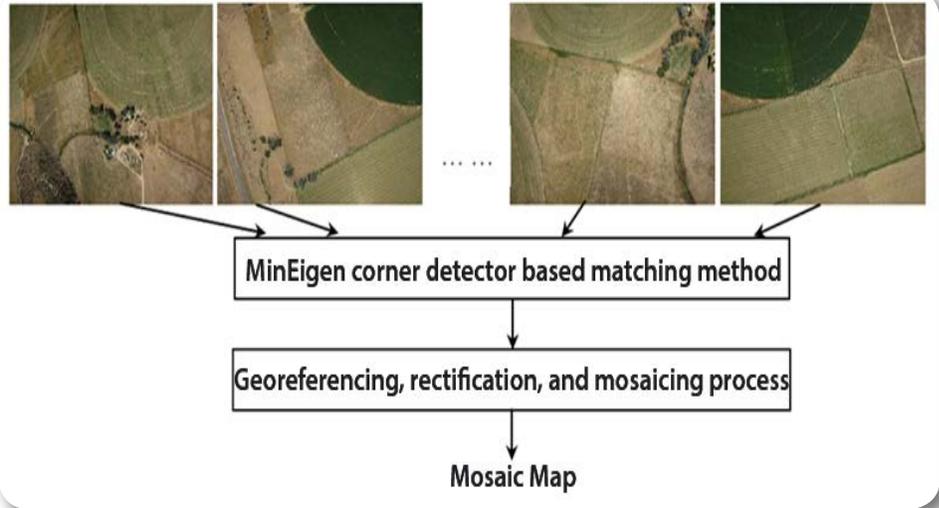
UCWRR researchers are collaborating with Department of Computer Science researchers to advance the state of the art in UAV image orthorectification to near real-time, making relevant scientific data available in a timely way for precision agriculture and others

**A**cquiring an accurate orthorectified mosaic map from the images captured by an unmanned aerial vehicle (UAV) system is currently a time-consuming and expensive process. The cost and delay of manually orthorectifying the images wastes money and manpower, while farmers and water managers have an urgent need for real-time or near real-time data to help them make efficient use of scarce water resources.

Dr. Xiaojun Qi in the Department of Computer Science at Utah State University is working with UCWRR researchers to apply novel computer vision techniques that will generate near real-time or real-time orthorectified mosaic maps using images from the AggieAir UAV remote sensing platform developed at the Utah Water Research Laboratory.

### Research

Five different matching algorithms were tested to find the best matched region in the base map for each aerial image. The MinEigen corner detector based matching method achieved the best performance and was used to implement the following processes:



The flow chart of the proposed approach

- ◆ Georeferencing
- ◆ Rectification
- ◆ Mosaicing

The experimental results are encouraging. Using a base map of the area as a reference, a reduced resolution mosaic map can be produced for a set of about 160 aerial images in about 30 minutes, significantly improving the acquisition time achieved by other software while providing comparable accuracy.

### Benefits to the State

These techniques have the potential to make remote sensing more cost effective and provide timely data that will benefit, among others:

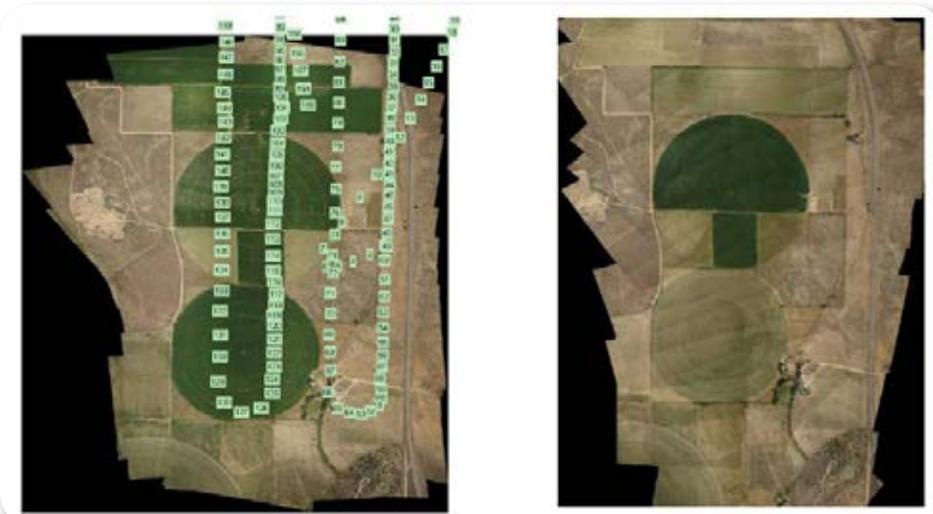
- ◆ Utah farmers by providing near immediate feedback on the detailed variations that exist within a given agriculture field so they can implement management policies to maximize yield while minimizing input.
- ◆ Utah water managers and researchers by providing real-time data to assess and manage water bodies in the state.

### Looking to the Future:

The need for cost-effective, real-time water management data is undisputed. Further research will aim to improve accuracy and reduce the time necessary to generate mosaic maps from remotely sensed data. ■

### Xiaojun Qi, Ph.D.

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The base map and the obtained pixel locations for 158 aerial images using GPS information. The mosaic map generated by using the estimated pixel locations, the projective transformation, and the average of pixel values of the overlapping re-orthorectified images



Awards and Recognition

UCWRR student and faculty awards in 2015 include the following:

Faculty Awards

- ◆ **David G. Tarboton:** Faculty Researcher of the Year at USU's 2015 Robins Awards. April 2015.
- ◆ **David E. Rosenberg:** Outstanding Service Award—Academic Sector, American Water Resources Association (AWRA), Utah Sector. April 2015.
- ◆ **Blake P. Tullis:** EWRI Fellow for 2015 at the AAWRE Diplomat Induction Ceremony, World Environmental & Water Resources Congress in Texas. May 2015.
- ◆ **R. Ryan Dupont:** Richard I. Stessel Waste Management Award at the 108th Annual A&WMA Conference and Exhibition in Raleigh, NC. June 2015.

Student Awards

- ◆ **Leila Hassan-Esfahani:** J. Paul Riley AWRA Student Paper Competition winner for her work on the contributions of Landsat and airborne products in monitoring surface soil moisture. April 2015.
- ◆ **Joshua Hortin:** First Place, ASCE Rocky Mountain Regional Conference technical paper competition for his work on the impact of nanoparticles in the environment. April 2015.
- ◆ **Adel M. Abdallah:** Best Research-Oriented Paper award from the Environmental & Water Resources Institute (EWRI) for his work on residential water and energy linkages and implications for conservation/management. May 2015. ■

Future Issues

Research Highlights:

“Virgin River Fish Barrier”

(UCWRR researchers are evaluating weaknesses in a fish barrier along the Virgin River that may allow invasive fish species to pass and recolonize in an area where managers are trying to re-establish native fish communities)

“ASR Protocol and Decision Support”

(UCWRR researchers have created a model for water providers that wish to intentionally recharge their aquifers to optimize aquifer storage and recovery in Utah)

FAR AFIELD

In this 'Year of Water,' the UCWRR has welcomed numerous dignitaries and other visitors. Our faculty have also traveled far and wide conducting and presenting their research and sharing their extensive water resources expertise



Dr. Mac McKee leading a tour for international visitors with the Utah Center for Citizen Diplomacy

The Year of Water has turned the focus of many in the State of Utah and around the world to the importance of water and water research.

In only the first six months of 2015, we have hosted a wide range of visitors to the laboratory, including local members of Rotary International, the Utah Board of Water Resources, a Utah legislative committee, State Engineers from the Western States, and visitors from Ethiopia, India, Israel, Russia, Saudi Arabia, and South Africa.

UCWRR faculty members have also served as visiting professors, provided professional training, and presented re-

search at conferences around the globe, including:

Sydney, Australia

Montreal, Canada

Liege, Belgium

Stavanger, Norway

A Coruña, Spain

Rotterdam, Netherlands

Copenhagen, Denmark

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