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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), which is 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 on-line at:

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

Message from the Director

Mac McKee, Director

Water related challenges continue to emerge in an increasingly complex society. The Utah Center for Water Resources Research (UCWRR) has a rich tradition of leadership in applied research on the world's water resources problems. This tradition continues today with internationally renowned UCWRR faculty and their students engaged in cutting-edge research in such areas as water quantity and quality management, real-time operations of large water delivery systems, dam safety, design of hydraulic structures, groundwater contamination clean-up, creation of new information systems to support the data needs of resource management agencies, and many others. This newsletter highlights a tiny fraction of the research and service activity provided by the Utah Center for Water Resources Research. ■

INSIDE:

Research Highlight:
"UAVs for Remote Sensing in Water Resources Management"

"Identification of Potential Risks to Utah Drinking Water from Chlorinated Solvents"

Far Afield:
Projects and Visitors

State Activities:
UCWRR projects in all 29 counties in the State of Utah

RESEARCH HIGHLIGHT

UAVs for Remote Sensing in Water Resources Management

Recent research at Utah State University has led to the development of ultra light, autonomous aircraft for use in capturing high resolution aerial imagery for application in irrigation management

Water use in agriculture is typically very inefficient, yet represents approximately 85% of Utah's water use. Small improvements in efficiency would provide additional water availability for agriculture or municipal supply. to achieve greater efficiencies, however, better and timelier information regarding soil moisture and evapostranspiration is needed by canal and reservoir operators, farmers, and other water managers. Current technologies for remote sensing (satellite- and aircraft-based sensors) are too expensive and provide information too infrequently to be of practical use to farmers or managers of large irrigation systems.

Raven

UtahStateUniversity

Research

An inexpensive unmanned autonomous vehicle (UAV) has been developed to address irrigation issues, as well as other remote sensing applications (e.g., riparian habitat mapping, road and highway surface monitoring, wetland mapping, fish and wildlife tracking) The UAV is a small aircraft with the ability to:

- Launch virtually anywhere because it is not dependent on a runway.
- Carry and control various types of remote sensing equipment, including cameras for RGB color and near-infrared platforms.
- Use on-board GPS, avionics, and programmable intelligence to fly a pre-determined flight path for up to one hour on a single charge, but still allow a ground control station to switch from autonomous to manual flight at any time.
- Control the acquisition and temporary storage of images to be downloaded and processed for remotely sensed data.
- Deliver raw aerial images and position and orientation data directly after the flight. Additional processing time can provide quick orthorectified georeferenced images or manually georeferenced mosaics.

Pilot Austin Jensen and Crew with UAV Spitfire

"An inexpensive unmanned autonomous vehicle (UAV) has been developed to address irrigation issues, as well as other remote sensing applications"

Benefits to the State

- Provides timely low-cost, highly detailed information on soil moisture and evapotranspiration rates.
- Enables canal companies and irrigation districts to provide highly detailed information to farmers that will help them better manage scarce irrigation resources and complex irrigation delivery systems more efficiently.
- Saves water that could be used to increase agricultural output or be allocated to other users (as much as 5 or 10 percent water savings in the Sevier River Basin alone).
- Brings recognition to USU and to Utah as a leader in the development of this cutting-edge technology for a variety of remote sensing applications.

Looking to the Future

The AggieAir Flying Circus has been established as a service center at the Utah Water Research Laboratory to provide high resolution, multispectral aerial imagery using a small, unmanned aerial system called AggieAir. Because AggieAir is a low cost, easy-to-use platform, the AggieAir Flying Circus is able to map small areas more quickly, more frequently, at greater resolution, and at a smaller cost than conventional remote sensing platforms (satellite and manned aircraft).

Future research to advance the capabilities of AggieAir include:

- Development of an improved IMU to increase accuracy and further minimize cost.
- Development of technologies to deploy multiple UAVs simultaneously for such applications as wind velocity field mapping, tagged fish tracking, and aerial image acquisition for larger areas.

For further information please visit http://aggieair.usu.edu. AggieAir was developed by the OSAM (http://www.engr.usu.edu/wiki/index.php/OSAM) team at the Center for Self-Organizing and Intelligent Systems (CSOIS) (http://www.engr.usu.edu/wiki/index.php/CSOIS) at Utah State University. Additional information can be found on their websites. ■

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Mac McKee, Ph.D.
Director, UCWRR and Utah Water Research Laboratory, Utah State University.

RESEARCH HIGHLIGHT

Identification of Potential Risks to Utah Drinking Water from Chlorinated Solvents

Researchers at the UCWRR have developed a user-friendly GIS tool to help assess sites in Utah that have groundwater contaminated with chlorinated solvents

Wide-ranging use of chlorinated solvents used extensively in the 1950s-1980s, along with inadequate disposal practices, has caused the contamination of groundwater across the United States including several locations in Utah. These chlorinated solvents are suspected carcinogens and show chronic toxicity to humans. A number of contaminated groundwater sites identified by the Utah Department of Environmental Response and Remediation (DERR) pose a real or potential risk to drinking water supplies across the State.

Research

A user-friendly GIS tool has been created that includes:

- A tool to integrate solvent source information with susceptible ground-water well receptor data for impacted communities.
- A fate and transport model plug-in to incorporate local aquifer properties into predictions of chlorinated solvent reaction and transport, as well as potential risk to groundwater extraction wells.
- A site evaluation protocol to help with on-going management of contaminated sites.
- Validation of the management tool and plug-ins at the Sugarhouse Well site that has resulted in closure of drinking water wells.

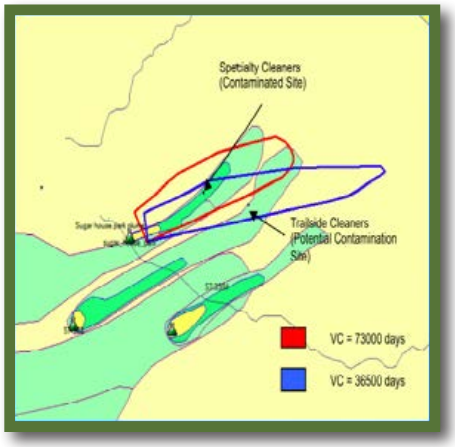
Benefits to the State

Use of the tool by the Utah DEQ will result in:

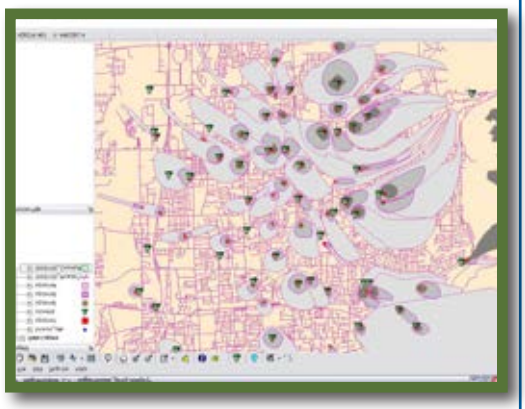
- Improved understanding of potential groundwater resource contamination.
- Information to prioritize actions needed at sites to protect groundwater supplies from contamination by chlorinated solvents.
- Positive impact on citizens living near chlorinated solvent impacted groundwater sites identified throughout the Salt Lake Valley, Bountiful, Delta, Logan, Ogden, Price, Tooele, Tremonton, Vernal, and Woods Cross areas.
- More efficient expenditure of public dollars based on risk management prioritization.
- Preservation of groundwater resources in the state through proactive control of high-risk sites.

Looking to the Future

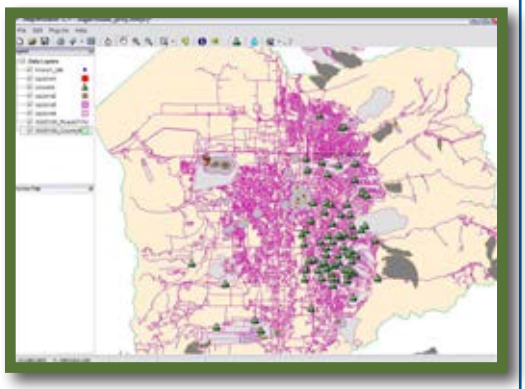
As experience is gained through use of the GIS-based solvent tracking tool by resources management agencies in Utah, the Utah Center for Water Resources Research will supply training in application of the tool and will work with management agencies to identify and implement needed upgrades and modifications. ■



Model Output: Delineation of restricted zones around the Sugarhouse Park Well for vertical conductivities of 73000 days and 36500 days. Shaded areas are reported Groundwater Capture Zones. Outlined areas are Modeled Groundwater Capture Zones



Groundwater Protection Zones for municipal, industrial and irrigation wells in the vicinity of the Sugarhouse Park Well



Source Water Protection Zones for Salt Lake County municipal, industrial, and irrigation wells

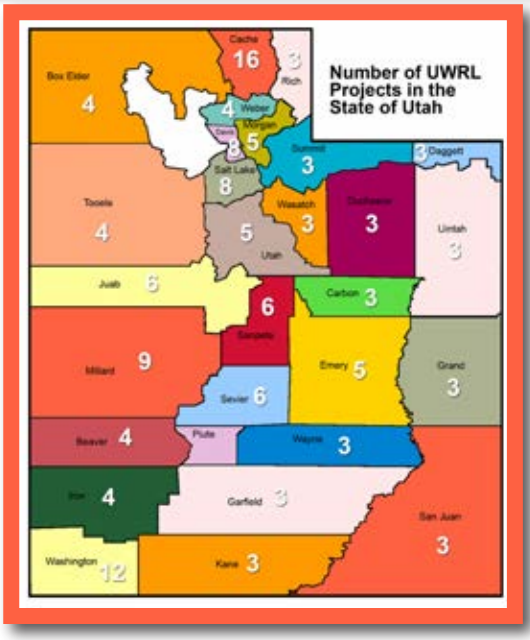
R. Ryan Dupont, Ph.D.
Professor, Department of Civil and Environmental Engineering, Utah State University.

Shounak Krishnanand
Student, Utah State University

State Activities

The UCWRR has research and training projects in all 29 counties of the State of Utah, as illustrated in the map. These projects are conducted under the auspices of the Utah Water Research Laboratory.

Projects address a wide array of water issues and applications, such as bioprocess engineering; fluid mechanics and hydraulics; groundwater and contaminant hydrogeology; hazardous, toxic waste, and air quality management; hydrology, water education and technology transfer; water quality engineering; and water resources planning and management. ■



Future Issues:

Research Highlights:

"Virgin River Temperature Modeling System." (UCWRR researchers have developed a two-zone dynamic instream water quality model to assist managers in evaluating alternative allocation strategies to address municipal, industrial, agricultural, and environmental water needs.)

"Defining Objectives for Meeting Mitigation Goals in Hydropower Relicensing." (Researchers at the UCWRR are working with state regulatory agencies to define objective measurements for evaluating instream flow requirements for FERC licensing.

Far Afield

The research programs and facilities at the UCWRR attract visitors from around the world. Recent delegations have been hosted, and UCWRR researchers have traveled to numerous countries, including:

Nam Ngum I Hydro Power Station, Nam Ngum Basin, Lao People's Democratic Republic

Accra, Ghana
Aleppo, Syria
Amman, Jordan
Amsterdam, The Netherlands
Bad Schandau, Germany
Baghdad/Erbil, Iraq
Brasilia, Brazil
Cairns/Canberra/ Melbourne/Queensland/ Sydney, Australia
Cairo, Egypt
Cape Town, South Africa
Colombo, Sri Lanka
Concepcion, Chile
Copenhagen, Denmark
Dakar, Senegal
Exeter, United Kingdom
Kigali, Rwanda
Laos
Malta
New Delhi, India
Palestine
Stockholm, Sweden
Tel Aviv, Israel
Vancouver, BC
Xi An, China ■

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