CAMPBELL SCIENTIFIC UPDATE

First Quarter 2010 Vol. 21, Issue 1

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Some Thoughts About Climate Change

Paul Campbell, President

Nearly everyone working in environmental science has been engaged in some way with the matter of climate change. Among customers of Campbell Scientific, I know and respect those who view current circumstances as a small blip in geologic time, and who point to a lack of consequential evidence of adverse effects from higher levels of carbon dioxide in the atmosphere. Others, whom I also know and respect, point out the peril of our current circumstance, very likely man-made, and the irreversible worsening of conditions conducive to human habitation, as indicated by some models. Considering these differing views, I am sometimes asked what I think we should be doing. Let me suggest three things that occur to me.

Continue to study

While there are differing views of science and public policy among individuals and nations, nearly everyone agrees that we should deepen our scientific knowledge of climate change causes and effects. As our scientific understanding increases, it is more likely that public policy will galvanize around the right direction. Another reason to continue to study is because we are better able to make observations and narrow the bands of uncertainty in models now than we were a few decades or years ago. For example, the relatively new and modern US Climate Reference Network is designed with the intent of making consistent measurements over decades to come.

Increase research and development of climate-neutral energy sources

We have been fortunate to enjoy combustion of fossil fuels without worrying too much about the emission of greenhouse gasses. The move to other sources of energy or the capture of harmful emissions will take significant research and development in advance of the investments in operational power plants and equipment. Moving to alternative and renewable energy sources might alleviate both ecological and political stresses. Our challenge is to find ways of doing it without introducing economic stresses.

Invest in energy efficiency

I participated in a carbon-flux workshop in Asia last year. As a panelist, I was to represent the view of an American businessman to participants, including a number of student members of an on-campus carbon tracker association. In preparation for the workshop, I asked a student intern to help me research my company's carbon footprint based on utility billings going back 10 years. Decatherms of natural gas and kilowatt-hours of electricity were converted to equivalent annual metric tons of carbon dioxide emissions. It was interesting and a bit discomforting to observe that the company is less energy efficient in our facilities and manufacturing processes than we were 10 years ago. I now have a heightened awareness and greater willingness to invest in buildings, processes, and equipment that are more energy efficient.

While nearly all of our marketing groups are supporting some customers working on an aspect of climate change, there are two groups that I would like to specifically mention. For many years, our Flux group has supported scientists studying processes that involve gas exchange at the earth's surface. Measurements of interest include water vapor, carbon dioxide, methane, isotopic ratios of atoms of a select gas, nitrous oxide, ammonia, and others. The understanding available to scientists of carbon and nitrogen cycles is expanding, and narrows the uncertainties about anthropogenic climate change and suggests possible improvements in agriculture and industry.

The second group I want to mention is our Renewable Energy group, formed in 2009. This group gives increased focus to customers working in solar, wind, and geothermal energy. It is exciting to see the enthusiasm among both customers and our application engineers in this area.

With high-fidelity measurement capabilities, Campbell Scientific will continue to play a role with our customers as they assess resources, monitor performance, and track the health of the earth's ecosystems.

CAMPBELL SCIENTIFIC UPDATE

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On the cover: Photo courtesy of the Center for Snow and Avalanche Studies (CSAS). Weather station at the CSAS Senator Beck Study Plot , Uncompahgre National Forest, CO.

Introducing the CR200X Dataloggers

In December 2009, Campbell Scientific replaced the CR200-series dataloggers with the CR200X-series dataloggers. The new dataloggers feature expanded memory for the program and operating system (OS).

The expanded memory allows:

- Up to 128 public variables instead of 48
- Up to eight tables instead of four
- Compiled CRBasic programs that are two times larger
- All CR200X instructions to be included in one standard OS

Like their predecessors, the CR200X-series dataloggers are small, lower-cost devices. Their single-ended input-channel configuration is optimal for measuring one or two sensors. Three of the models include internal spread-spectrum radios, allowing them to be part of a wireless sensor network.

CR200X Models

CR200X—Base model

CR206X—Includes internal 915 MHz spread-spectrum radio (US and Canada) that transmits data to another CR206(X) datalogger, an RF401 radio, or an RF430 radio

CR211X—Includes internal 922 MHz spread-spectrum radio (Australia and Israel) that transmits data to another CR211(X) datalogger, an RF411 radio, or an RF431 radio

CR216X—Includes internal 2.4 GHz spread-spectrum radio that transmits data to another CR216(X) datalogger, an RF416 radio, or an RF432 radio

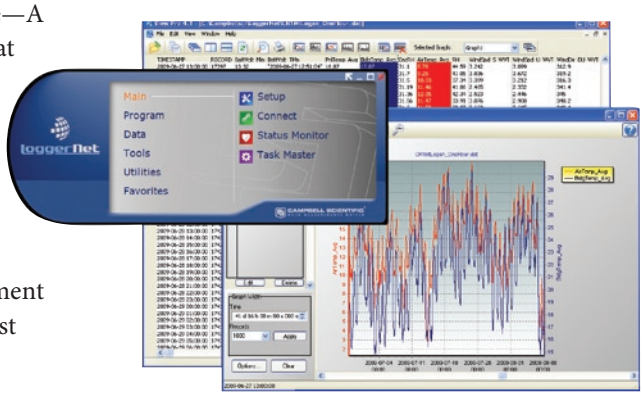
CR295X—Used with the TX312 HDR GOES satellite transmitter

The Year in Review: New Products

It's been a productive year since Campbell Scientific last mailed you a copy of the *Campbell Update* newsletter. Within that year, quarterly email newsletters have announced our many new and updated products. Since some of you are not signed up for our email newsletter, here's an overview of those products:

- **LoggerNet 4**—A major upgrade to our main datalogger-support software package that features a new tool for designing and configuring PakBus networks, a more powerful file viewer, a redesigned toolbar, and many updates to existing clients
- **05103-45 wind speed and direction sensor**—An ice-resistant instrument manufactured by R.M. Young
- **27106T anemometer**—R.M. Young's low-threshold, precision air-velocity sensor, especially suited for monitoring vertical wind
- **Archer-OBS**—A small, handheld device that can be carried to the field for displaying OBS-3A measurements, running surveys, and setting up the OBS-3A for extended deployment
- **Archer-PCon**—An ultra-rugged field PC that provides a portable data-collection solution for Campbell Scientific data acquisition systems
- **RF430 radios**—A spread-spectrum transmitter that connects to a PC's USB port
- **CS475, CS476, and CS477 radar sensors**—Instruments that determine water level by emitting short microwave pulses and then measuring the elapsed time between the emission and return of the pulses
- **CS525 pH probe**—A rugged device that incorporates Sentron's high-tech, ion-selective field-effect transistor (ISFET) as its pH-sensitive element (ISFET is the most powerful pH-monitoring technology available today.)
- **Visual Weather 3**—New version of our software that supports our general weather stations with added support for the ET107
- **CS470/CS471 bubblers**—Sensors that use compressed air to measure water depth

If you would like to stay up to date on our latest product offerings, please sign up for the quarterly email version of this newsletter. Newsletter subscriptions are handled in our Customer Center. Refer to the Customer Center article on page 8 for registration instructions.



The Flux Group

Interest in the quantification at the ecosystem level of fluxes in carbon dioxide, water vapor, and energy has increased in recent years due to increased interest in global carbon and hydrologic cycles. At Campbell Scientific, the goal of the Micrometeorology Flux group is to help scientists around the world measure these various fluxes.

Eddy covariance (EC) is frequently used to measure fluxes. EC is an atmospheric flux measurement technique used to measure and calculate vertical turbulent fluxes within atmospheric boundary layers. These flux measurements are widely used to estimate heat, water, and carbon dioxide exchange, as well as the exchange of methane and other trace gases. The EC technique is also used extensively for verification and parameterization of local, regional, and global models of climate, weather, biogeochemistry, and ecology.

EC measurements require high precision, high-frequency response, and large data-storage capacity. Campbell Scientific dataloggers and sensors meet these requirements.

Campbell Scientific offers both standard and extended open-path eddy-covariance (OPEC) systems. The standard system consists of:

- Flux-suitable datalogger
- 3-D sonic anemometer
- Open-path infrared gas analyzer
- Temperature and relative humidity probe

The extended OPEC system includes additional sensors for energy-balance measurements. By examining the energy-balance closure, it is possible to evaluate how well the EC data were estimated. These additional sensors include the following:

- One net-radiation sensor
- Two averaging soil thermocouples
- Two water-content reflectometers
- Four soil heat-flux plates

The EC technique is mathematically complex and requires significant care in setting up the instruments and in processing the data. Application engineers from the Flux group help customers work through these complexities. They consult on solution design and help select the system and sensors that best fit the site and measurement requirements. Some of them support customers by phone, on line, and in person; others work in research and as application scientists. They write datalogger software programs and maintain libraries of programs. These engineers also teach the training classes that cover both of our OPEC systems. Eddy-covariance training courses are listed at www.campbellsci.com/training.

Campbell Scientific's Micrometeorology Flux group has engineers with advanced degrees and many years of experience. They are promoting this very specialized branch of science with cutting-edge engineering, development, and applications. If you have any questions relating to flux measurements, don't hesitate to contact a member of this group.

Featured Application: Know Your Snow

With the arrival of winter in the Northern Hemisphere, many of us here in Logan, Utah, welcome the snow. Our vehicle license plates in Utah say "Greatest Snow on Earth," and the ski resorts are a popular destination for those looking to experience it.

The snow, with all of its implications for play, travel, danger, and spring runoff, creates many needs for making measurements, and many snow-related applications benefit from our measurement and control systems. Our systems see use in and around ski areas, winter recreation areas, mountain towns, major highways, and other critical locations.

Ski areas, departments of transportation, and other organizations rely on automated weather stations to provide real-time weather data for use in evaluating avalanche danger. Many weather factors contribute to avalanche conditions, including significant precipitation, wind, and changing temperatures. The around-the-clock access to weather data from remote locations is a huge help to those involved in determining avalanche risk.

Ski resorts use measurement and control systems for other management and maintenance decisions, as well. Weather stations can control snow-making equipment based on measured conditions. Wind measurements can help determine when wind speeds are too high to safely operate lifts. New snow totals are always of interest to skiers. This information can be automatically posted to the Internet and displayed in graphical formats.

We've all seen how snow and ice affect our roads and we've seen the dangers they cause. By measuring precipitation, road-surface temperature, air temperature, and other parameters, road weather stations provide departments of transportation with critical information for keeping roads clear and safe. Weather station data can help road crews know where they need to plow, whether to lay salt or sand, and which roads may need to be closed.

Water managers also benefit from good measurements. Constant monitoring of the snowpack in mountain regions helps predict high and low water years and gives both government and private organizations time to act accordingly. The SNOTEL network of over 750 weather stations in the western United States gathers this type of data for water managers and decision makers. Data from the network have been used to accurately predict water supply well before spring runoff, resulting in better water management, informed farming and business decisions, and even advance flood preparation.

Low power consumption, multiple remote telemetry options, and reliable operation in harsh environments make our systems a natural fit for these and many other snow-related applications. It is always gratifying to know that our systems are contributing to operational and research goals of many different organizations by providing reliable, long-term monitoring.

Typical Measurements

Wind speed and direction
Air temperature
Relative humidity
Precipitation
Snow depth
Solar radiation
Barometric pressure

Other Possibilities

Snow water content
Water temperature
Soil temperature
Soil moisture
Camera

Virginia Upgrades Flood Warning System

In the early 1980s, the National Weather Service (NWS) initiated the Integrated Flood Observing and Warning System (IFLOWS) throughout the Appalachian region of the Eastern U.S. The IFLOWS program expanded quickly in the early 1990s, and now covers flood-prone regions in 12 states.

As an IFLOWS cooperator, the Virginia Department of Emergency Management (VDEM) developed a network of nearly 300 gauging stations that use the ALERT communication protocol. Data from this extensive network are shared with the NWS and other cooperators through the IFLOWS network.

Many advances in technology have been made since the rapid growth of the Virginia IFLOWS network in the 1980s and 1990s. Additionally, pressure to comply with FCC regulations for narrow banding increased. These issues led VDEM to begin a network-modernization effort by exploring and evaluating the newest generations of ALERT platforms.

Their search led them to MapTech of Blacksburg, Virginia, who worked with Campbell Scientific to provide a solution. Using the CR200 and CR800 dataloggers and RF500M intelligent radio modem, MapTech created packaged transmitters with both measurement and telemetry abilities.

The systems meet VDEM's ALERT needs while providing capability and flexibility not present in their existing hardware.

The core product features include:

- Drop-in replacement for existing transmitters
- Compact size to fit in 12-inch standpipes
- Time- and event-driven ALERT data transmission
- ALERT packet repeating and logging
- Programmable acquisition and logging of sensor data
- Programmable control of lights, gates, and other devices
- Two-way communication support
- Field upgradable to support new protocols and telemetry methods

Over 90 transmitters are currently being deployed throughout Virginia. The stations in the network that monitor water level with pressure transducers and ultrasonic sensors have special signal converting and data scaling needs. These stations also need to log all measured data—not just the transmitted flood-warning information—for sharing with agencies to use in analysis of historical measurements. Since the new packaged transmitters can handle all these needs better than the old ones, the water-level-measuring sites are receiving top priority during deployment.

The new transmitters have proved to be easier to program and to provide more diagnostic information than the previous transmitters. They are fulfilling the promise of a drop-in replacement, with all the capabilities of the old system plus significant added features.

www.campbellsci.com/virginia-alert

Enclosure Changes

We are increasing the diameter of the conduits on our general purpose enclosures from 1.25 in. to 1.5 in. The conduits are at the bottom of the enclosure and allow entry of multiple sensor cables. This diameter change will make it easier to fit larger cables, such as RS-232 cables. These changes will be phased in over the next couple of months for the following models: ENC10/12, ENC10/12R, ENC12/14, ENC14/16, and ENC16/18.

Also of note is a new option on our largest enclosure (ENC16/18) that includes a sideplate (along with the standard backplate). This option provides even more mounting space.

System Monitors Seepage at Wolf Creek Dam

The Wolf Creek Dam near Jamestown, Kentucky, was constructed partially as a regular concrete hydroelectric dam, but mostly as an earth-fill embankment structure. Finished in 1950, within 20 years it developed serious reservoir seepage problems. Several repair projects had a degree of success at stemming the flow, but in recent years managers decided that resurging seepage at the dam constituted an emergency situation.

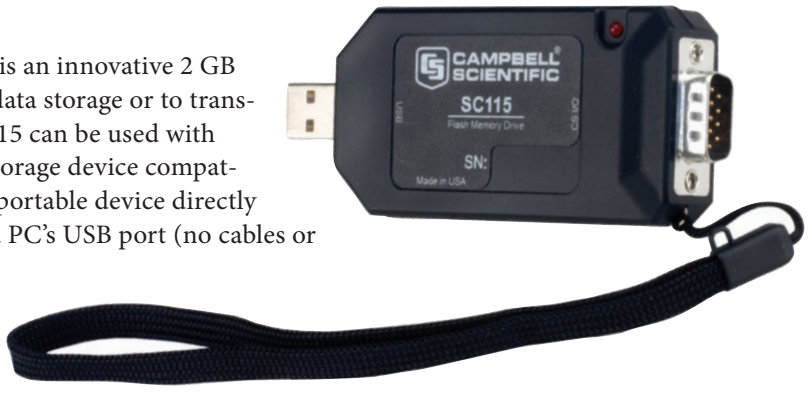
To seal off further damaging seepage, remedial construction began in 2006. The project includes a major grouting program to be followed by construction of a nearly 1,000,000-square-foot concrete diaphragm wall. As part of the monitoring and analysis portion of the project, the Army Corps of Engineers (USACE) retained URS Corporation to design, install, and operate an automated data acquisition system (ADAS). The ADAS monitors the large number of piezometers measuring water level (seepage from the reservoir) in the embankment.

System installation began during the summer of 2008. All instrument readings are collected by a host PC located in the dam's powerhouse. A local FTP server provides remote transfer of daily data files to both the Corps' Nashville district office and the URS St. Louis office, where data are being managed in the USACE WinIDP program. In addition, URS is hosting a project web server that displays graphs and instrument readings every hour.

The ADAS consists of 81 vibrating-wire pressure transducers being read by Campbell Scientific CR1000 dataloggers and 25 AVW206 wireless interface units. The AVW206 uses Campbell's revolutionary spectral-analysis method to eliminate almost all noise from the vibrating-wire signals. All data is transmitted over a spread-spectrum IP radio network. As part of the project, URS installed an 800 ft fiber optic cable to carry the radioed data from atop the dam structure down to the communication room in the dam's power house. URS performs operation and maintenance of the ADAS to keep track of seepage levels as dam repair progresses through 2014.

www.campbellsci.com/wolf-creek

New USB Storage Drive



The SC115 CS I/O-to-USB Flash Memory Drive is an innovative 2 GB device that allows you to augment your onsite data storage or to transport data between the datalogger and PC. The SC115 can be used with most of our CRBasic dataloggers, and is the only storage device compatible with our CR800 and CR850. This lightweight, portable device directly connects to either the datalogger's CS I/O port or a PC's USB port (no cables or interfaces required).

Tips and Tricks: Crash!

Has your computer ever crashed? Ever lost your hard drive? Have you ever upgraded your computer? Everyone probably answered yes to at least one of these questions. If not, consider yourself lucky—and get ready.

So, how can you prepare LoggerNet for the inevitable? *Back it up*, of course. LoggerNet's backup wizard provides a simple way to back up the Network Map and other important files. You will still need to store that backup in a secure place, say with your original LoggerNet disk. But after a catastrophe you can be up and collecting data in no time.

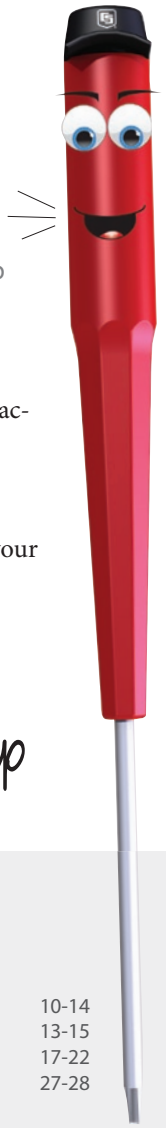
The backup wizard is accessed through LoggerNet's Setup screen. In LoggerNet 4, it is under the Network menu. In LoggerNet 3, it is under the Tools menu. The *Back Up and Restore* tutorial at www.campbellsci.com/backup will walk you through the steps.

PC400 and PC200W can also be backed up and restored similarly to LoggerNet. In those products, this feature is accessed through the Network menu.

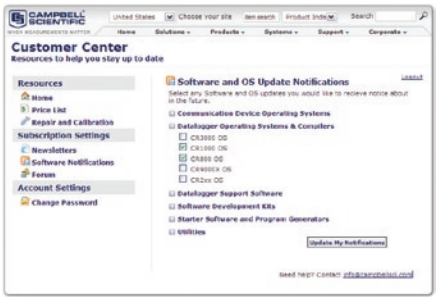
Not only is backing up your network preparation for recovery after a disaster, it is also a great tool to copy your network from one computer to another. What are you waiting for? *Back it up* now—and be prepared.

Holding on tightly,

Tip



Not Registered for the Customer Center?



If you haven't taken the opportunity to register for our online Customer Center, we encourage you to do so. As a fairly new addition to our website, the Customer Center provides services that you may find useful, including:

- Access to our U.S. price list
- Notifications of datalogger OS and software updates
- Newsletter subscriptions
- Address-change forms
- Access to our user forum

Other resources will be added in the future. Customer Center accounts are available to current customers. If you would like an account, visit us at www.campbellsci.com/register. To register, you'll need to enter your name and Campbell Scientific customer number. You'll find this underlined on the address label of the envelope in which this newsletter arrived. Or, you can request your number from the registration web page and we'll email it to you.

Trade Show Calendar

January		
TRB 89th Annual Meeting	Washington, DC	10-14
Four States Irrigation	Fort Collins, CO	13-15
AMS Annual Meeting	Atlanta, GA	17-22
Unified Wine & Grape Symposium	Sacramento, CA	27-28
February		
World Ag Expo	Tulare, CA	9-11
Golf Industry Show	San Diego, CA	10-11
GeoFla	West Palm Beach, FL	20-24
Concrete Bridge Conference	Phoenix, AZ	24-26
March		
Rural Water Association of Utah	St. George, UT	1-5
Aquaculture 2010	San Diego, CA	1-5
Distributech	Tampa, FL	23-25
April		
FHWA Bridge Engineering	Orlando, FL	8-9
NWQMC	Denver, CO	25-29
May		
Southeast Dam Safety	Charleston, WV	3-8
ACWA California Water Agencies	Monterey, CA	4-7
ALERT Users Group	Palm Springs, CA	4-7
EWRI / ASCE	Providence, RI	16-20
ASES Solar Conference	Phoenix, AZ	17-22
Windpower	Dallas, TX	23-26
PCI 2010	Washington, DC	29-2
June		
WEDA / TAMU	San Juan, PR	6-9
International Bridge Conference	Pittsburgh, PA	6-9
A&WMA	Calgary, Canada	22-25
USGS Sedimentation	Las Vegas, NV	27-1
Society of Wetland Scientists	Salt Lake City, UT	27-2

Visit our website for training class schedules and additional listings.

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