# CAMPBELL SCIENTIFIC UPDATE

Third Quarter 2010 Vol. 21, Issue 3

New Open-Path and Closed-Path Analyzers ***p. 2***
Water Sampler Product Line Added ***p. 3***
New Surface-Mount Thermistor ***p. 3***
Case Study: Air Quality in Nevada ***p. 4***
Case Study: Bridge Expansion in Louisiana ***p. 5***
New Freezing-Rain Sensor ***p. 6***
High-Accuracy Pressure Transducer Available ***p. 6***
Website Product Information Upgraded ***p. 7***
Upcoming Trade Shows ***p. 8***

# New Open-Path and Closed-Path Gas Analyzers

We are pleased to introduce two new analyzers for measuring atmospheric levels of carbon dioxide and water vapor: the EC150 (an open-path sensor) and the EC155 (a closed-path sensor). We designed these sensors to produce high-quality measurements in the field and to work closely with our other flux system components to create fully integrated eddy-covariance flux systems.

Eddy covariance (EC) is a technique frequently used to measure the transfer of water vapor and carbon dioxide—the two most prevalent greenhouse gases—between the atmosphere and the earth's surface. Interest in EC systems has increased over the years in parallel with concerns about climate change. While we've sold and supported EC systems for years, the EC150 and EC155 represent significant advancements in this area. Of particular note are the design features relevant to measurement quality and tight integration with other key EC system components.

Special consideration was given to the analyzers' shapes, resulting in aerodynamic structures that minimize wind distortion. Their slim design, along with the reduction of internal active heat sources, minimizes error caused by the effects of analyzer body heating. Factory calibration over a wide range of pressures, temperatures, $CO_2$ and $H_2O$ densities, and levels of window contamination further reduces measurement error.

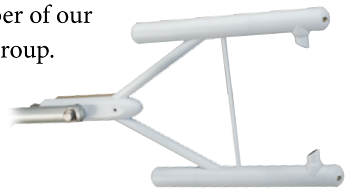
The analyzers provide low-noise measurements and offer a broad list of diagnostic parameters to warn of questionable data. Sample rates up to 50 Hz are supported, with user-selectable bandwidths ranging from 5 to 25 Hz.

One of the most significant benefits of the sensors is their ability to fully integrate with our other measurement products to form complete eddy-covariance systems. The sensors are designed to fit well with the body of the CSAT3A, providing co-location of the gas and wind measurement volumes, critical for good eddy-covariance measurements. The two sensors also share common electronics—reducing cost, simplifying installation, and providing time synchronization between the sonic and gas measurements before the data are output to the datalogger. This level of integration has been unavailable in previous eddy-covariance systems.

Adding one of our flux-compatible dataloggers to the EC150 and CSAT3A creates a complete open-path system. A complete closed-path system requires the integration of pump, valves, datalogger, and sonic anemometer, along with the EC155. We've packaged all of these components into the CPEC200, a field-ready system with all the engineering done for you.

Both of the new sensors were designed to perform well in the field. They operate in harsh environments and require very little power—even the CPEC200 closed-path system with its pump and valves can operate on solar and battery power. The analyzers are field serviceable, with easy access to the chemical bottles (and sample cell in the case of the EC155) without having to dismount the sensors from the installation. The windows on both sensors are tolerant of contamination. The EC150 windows are slanted to help shed water for better performance in the rain.

We look forward to the improvements these sensors will bring to eddy-covariance measurements. For more information, please speak to a member of our Flux group.



The EC150 measures trace gases as they pass through the measurement space.

The EC155 draws air samples from the measurement space and analyzes them internally.

## Open-Path Versus Closed-Path Eddy-Covariance Systems

**Advantages of Traditional Open-Path EC Systems:**

- Simpler operation and maintenance
- Reduced power requirements
- Better frequency response
- No tube delays—better preserves temporal correlation with anemometer

**Advantages of Traditional Closed-Path Gas Analyzer:**

- Automated $CO_2$ zero and span ($H_2O$ span more difficult)
- Better rain performance
- Less flow distortion on anemometer
- Density corrections for temperature not needed (maybe)

**Improvements Brought by the EC150 Open-Path Analyzer:**

- Minimal flow distortion on anemometer
- Better spatial correlation with anemometer
- Half the power requirement of traditional open-path

**Improvements brought by the EC155 Closed-Path Analyzer:**

- Significantly less flow distortion on anemometer than traditional open-path analyzer, slightly less flow distortion than aerodynamic open-path analyzer
- Less power required than traditional closed-path analyzer, more power required than open-path analyzer
- Small density corrections for temperature accomplished with thermometer in sample cell

# Water Sampler Product Line Added

Campbell Scientific is now offering five SIRCO automatic water samplers for storm water, waste water, or other water-quality applications. These samplers use external vacuum pumps to draw water through intake tubing, instead of the traditional peristaltic pumps that induce flow by squeezing flexible tubing. Advantages of the vacuum pump method include faster sampling rates, better vertical lifts, longer sampling distances, and less maintenance. Because the vacuum method disturbs the water samples less, they better represent the original water solution, especially if the solution has high concentrations of suspended solids. To prevent cross contamination, the SIRCO samplers use air pressure (up to 28 psi) to purge the tubing of excess water.

The PVS4150, PVS4120, and PVS4100 are portable, battery-operated water samplers. Designed for easy transport, the PVS4150 includes wheels, a telescoping handle, and a rugged case. The PVS4120 is the lightest sampler, weighing only 27 lb. The PVS4100 has a bigger pump that supports the fastest sampling rates, highest vertical lifts, and longest sampling distances. It also can use wider tubing (5/8-in. ID), which is better for handling large solids.

The CVS4200 and BVS4300 are stationary, AC-powered water samplers. They use the same big pump as the PVS4100 and support all of its capabilities. Both of the stationary samplers can include a refrigerator to keep the samples at the EPA-recommended temperature of 4∫C. The CVS4200 is an indoor sampler that has a corrosion-resistant steel enclosure. The BVS4300 is an outdoor sampler designed to handle extreme environments. It has a corrosion-resistant steel enclosure with a locking door and bolted-down instrument panel.

Case Study

# Air Quality in Nevada


Since its beginning in 1981, the main purpose of the Community Environmental Monitoring Program (CEMP) has been to involve the people from the communities around the Nevada Test Site (NTS) in its off-site monitoring program for radiation. After all, who would you rather ask if it is safe to live in your community, your neighbor who shares your concerns or a stranger who lives elsewhere? The NTS is located 65 miles north of Las Vegas and is larger than Rhode Island, so monitoring the off-site area means the CEMP covers quite a bit of ground (29 stations in Nevada, Utah, and California around the NTS).

When the program started, the stations required weekly visits by Environmental Protection Agency (EPA) personnel. Air filter samples, barograph strip charts, and magnetic cassettes used to store data from the background gamma detector were collected. Data from the cassettes could not be downloaded until the EPA technicians were back in the office, meaning that it was often a week or more before the data were reviewed, and results were not available to the public until even later. Thanks to technological advances in data storage and transmission, and the ability to remotely program the instruments, the data from the majority of the CEMP stations are now available in near-real time at www.cemp.dri.edu.

Today, the Desert Research Institute (DRI) of the Nevada System of Higher Education manages the CEMP for the U.S. Department of Energy, National Nuclear Security Administration (DOE/NNSA) Nevada Site Office. In 1999, when DRI began management of the program, a full suite of weather instruments was added to the stations, and the data from them, as well as from the primary background gamma radiation instrument, are stored and transmitted from Campbell Scientific CR1000 dataloggers. A variety of methods are used to get the data to the CEMP web page. In the most remote locations, the information is transmitted by GOES satellite from which data can be downloaded every hour. In locations with Internet access, CEMP uses the Campbell NL100 Ethernet interface to transmit data, and there is one location that uses a Campbell phone modem.

The CEMP network relies on fixed stations. But what if you had a temporary data gap to fill, or needed to collect data at a location where a permanent station was not needed? For this, DRI has developed its portable environmental monitoring stations (PEMS). For the DOE/NNSA in Nevada, PEMS have been used for monitoring emissions from a range fire, for testing equipment to measure radon, and for solar-powered air sampling where no line power is available. The PEMS have also been located next to a permanent CEMP station as part of quality assurance to ensure data collection accuracy.

DRI came up with the basic design for a PEMS by taking all the equipment one would find at a CEMP station and placing it on a flat-bed trailer. A PEMS can be readied for transport in under an hour and be back in use within an hour of arrival at its next location. Other advantages of placing the equipment on a flat bed are that the equipment maintains the same configuration from location to location, has a relatively small footprint, and can be customized as necessary.

The configuration of the PEMS is a 15-ft weather tower (which can be laid down on the bed of the trailer for transport), the meteorological instruments that go on the tower, and a pressurized ion chamber for background gamma detection. All of this is powered by solar panels, with a GOES satellite system for data transmission. Wireless internet, DSL, and phone sys-

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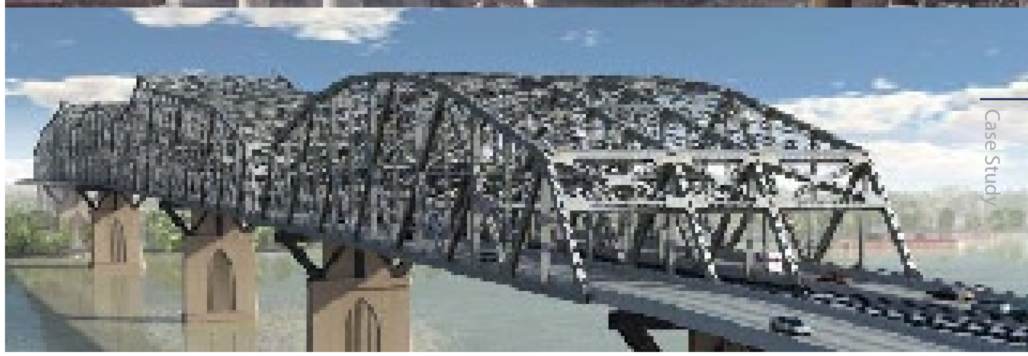



# Monitoring Bridge Expansion in Louisiana

The four main spans of the Huey P. Long Bridge over the Mississippi River in New Orleans, Louisiana, extend nearly 2,400 ft. This cantilevered steel through-truss bridge opened to traffic in 1935 and is owned and operated by the New Orleans Public Belt Railroad. The bridge currently carries dual rail lines between the trusses and two lanes of vehicular traffic cantilevered to the exterior of each truss. Based on the need to improve vehicular traffic flow and constraints due to uninterruptible rail traffic, the Louisiana Department of Transportation and Development (LA DOTD) decided to widen the bridge rather than replace it.

The bridge widening will increase the roadway on each side from its current width of 18 ft to 40 ft. It will entail the addition of upstream and downstream trusses parallel to the existing truss. The bridge piers are being modified with additional concrete encasements and steel frame to support the two new widening trusses.

A structural health-monitoring program is included in the construction contract as a proactive measure to assess whether the anticipated amount of load is being transferred from the widening truss members to the existing truss members.

CTLGroup was awarded the contract to design and install the truss monitoring system according to the specifications for the Huey P. Long Bridge widening project. The truss monitoring specification required the following:


- Determination of initial dead-load stresses in existing eyebar members
- Installation of strain gages for measurement of construction-related stresses in 433 members
- Installation of strain gages for measurement of live-load stresses in 31 members
- Installation of biaxial tilt meters on each of the five existing bridge piers
- Monitoring system to read the gages, make comparisons with predicted values, and provide daily reports throughout the three-year construction process
- Performing load testing to calibrate the monitoring systems

A total of 433 existing truss members are monitored with an array of 827 static and dynamic strain gages designed to measure axial and bending load effects. In addition, tilt meters monitor the inclination of the piers. For the static system, CTLGroup chose vibrating-wire strain gages based on cost, built-in temperature compensation, and the ability to run long distances with lead wires.

The truss-monitoring data-acquisition system is composed of a static-load monitoring system and a live-load monitoring system. (See bottom left figure.) The static system uses 23 track-side-mounted NEMA enclosures that contain AM16/32B multiplexers and AVW206 spectral-analysis modules to read the vibrating-wire strain gages. In addition, five piers are monitored using ten vibrating-wire tilt meters as well as ambient temperature, wind speed, and wind direction sensors.

Wireless communication—saving miles of cabling and hundreds of hours of labor—is accomplished using the spread-spectrum radio built into each of the AVW206 analyzers and an RF401 spread spectrum radio at each CR1000 datalogger and at the central computer. AVW206 modules read the vibrating-wire sensors that are attached to the AM16/32B multiplexers, perform the signal processing, and transmit the data wirelessly to one of four CR1000 dataloggers. These dataloggers then use the radios to transmit the data wirelessly to the office trailer approximately one-fourth mile from the bridge site.

The purpose of the system is to measure stresses (strains) in bridge members and compare them with predicted responses during the bridge-widening construction process.

Continued on p. 8

# New Freezing Rain Sensor

Campbell Scientific's 0871LH1 Freezing Rain Sensor detects the presence of icing conditions so that appropriate actions can be taken to prevent damage to power and communication lines, to warn of road hazards, or to keep ice off of an airplane's wings.

The sensor is also useful in wind-power applications to help determine when ice is forming on turbine blades. Ice on a wind turbine's blades is undesirable because:

- The blade can throw large chunks of ice a considerable distance—an extremely dangerous, potentially lethal situation.
- Formation of ice can cause unbalanced loading on the turbine's blades, bearings, and gear box.
- Ice reduces the turbine's power output.

The 0871LH1 can also be used for wind prospecting applications by helping predict the amount of time a potential wind power site may be out of commission due to icing conditions. Additionally, the sensor lets users know when ice is preventing their wind sensors from providing data.

The 0871LH1 uses resonant frequencies to determine the presence of icing conditions. Its main component is a nickel alloy rod that has a natural resonant frequency of 40 kHz. As ice collects on the rod, the added mass causes the resonant frequency to decrease. When the frequency decreases to 130 Hz (or a 0.02-in. layer of ice), an internal heater automatically defrosts the sensor.


# High-Accuracy Pressure Transducer Available

If you need high-accuracy water level/pressure measurements, you may be interested to know that we recently added a high-accuracy option to our CS450 Pressure Transducer. We introduced the CS450 early last year with the goal of offering a high-quality instrument and providing shorter lead times for ordering and recalibration. With hundreds of these sensors now in continuous operation throughout the world, we're happy to report that we've achieved this goal. The CS450 has demonstrated excellent quality, reliability, and measurement accuracy.

The new high-accuracy option provides an accuracy of ±0.05% full scale. Like our standard version of the CS450, measurements are temperature compensated over a 0°-to-60°C temperature range, allowing for use in many environments. The high-accuracy option also includes a calibration certificate specific to each unit. The standard version of the CS450 measures pressure with an accuracy of ±0.10% full scale.

The CS450 outputs either an SDI-12 or an RS-232 signal. All of our contemporary dataloggers, as well as many retired dataloggers, are compatible.

The standard CS450 has a stainless-steel case. A more rugged version of the sensor, the CS455 features a titanium case for use in corrosive environments. The CS455 features all of the same great measurement specifications of the CS450, including the high-accuracy option.

Contact our Water Resources group at (435) 750-9691 for more information on this and other water level and flow monitoring instruments.

# Website Upgrade Expands Product Information

If you've been on our website recently, you may have noticed a few changes. We've made three significant improvements that will make it easier to find information about our products. First, there are hundreds more products available on the site. In the past, we typically listed our major products. Now, you can view many replacement parts and accessories that complement our major products.

The second major improvement is that there is significantly more information for most products—so much so that we've organized it into five tabbed sections. Take a look at the table to the right to see the information we included in each section.

The third major improvement is the ability to see pricing right on the website. This feature is available only to customers who have purchased from us. Customers who have purchased from us and have registered for an account will see pricing on each product's Ordering Info tab, along with all of the product's options. If you are a qualifying customer, see the instructions in your newsletter email to register, or visit the registration page on our website at www.campbellsci.com/register.

For those who have not yet purchased from us, we continue to offer the Quick Quote feature, which allows you to submit a list of products and then receive pricing customized to your region.

We are interested in hearing your feedback. Please let us know if you have suggestions that will help us improve our website.


**Overview tab:**
Short product description
Product benefits
Related case studies
Product images and documents
Related products

**Specifications tab:**
More thorough technical description
Major specifications
Weights and dimensions

**Compatibility tab:**
Matrix of compatible dataloggers
List of compatible software
Other relevant compatibility details

**Ordering Info tab:**
Table showing:
- Product model number
- Ordering options
- Accessories
- Replacement parts
- Related services
- Pricing (if registered as a qualified customer)

Ships With list
Shipping weights and dimensions

**Support tab:**
Self-help resources:
- Related documents
- List of related software downloads
- FAQs

External help resources:
- Link to the forum
- Ask an Expert form
- Technical support phone number

# New Surface-Mount Thermistor

The 110PV is a new surface-mount thermistor for measuring temperature on the back of a solar panel. Panel temperature is an important measurement in solar energy applications since the output of a solar panel is affected by its temperature. As the temperature of the solar panel increases, its output decreases.

Features of the 110PV include a wide measurement range of -40° to +120°C, and the ability to make accurate measurements in environments with heavy electromagnetic interference. It is also easy to install—adhesive strips on the 110PV's smooth face adhere to the back of the solar panel.

## Air Quality in Nevada

Continued from p. 4

tems may also be added, but those tend to be options only in populated areas.

In keeping with the CEMP station configuration, an air sampler and its enclosure were added to the trailers. But the air sampler requires 120 Vac to operate and, as such, is the limiting factor for remote-area operation. DRI has operated the PEMS in locations without AC power when only meteorological and background gamma radiation instruments that could be powered by small solar panels were needed.

To date DRI has built three trailers for four different projects, and they have operated successfully in extreme environments, from the low deserts of Tecopa, California (near Death Valley), to the high deserts of central Nevada with elevations over 6,000 ft. The flexibility and programmability of the Campbell Scientific dataloggers have made it relatively easy to add other instruments used on the PEMs for these projects (radon detectors, solar-powered air samplers, and dust flux sensors).

# Trade Show Calendar

| | | |
|---|---|---|
| **June** | | |
| A&WMA | Calgary, Canada | 22-25 |
| USGS Sedimentation | Las Vegas, NV | 27-1 |
| Society of Wetland Scientists | Salt Lake City, UT | 27-2 |
| **July** | | |
| IABMAS 2010 | Philadelphia, PA | 11-15 |
| Hydrovision International | Charlotte, NC | 27-30 |
| **August** | | |
| StormCon 2010 | San Antonio, TX | 1-5 |
| ESA 95th Annual Meeting | Pittsburgh, PA | 1-6 |
| 8th Intl. Short & Medium Span Bridges | Ontario, Canada | 3-6 |
| Recirculating Aquaculture | Roanoke, VA | 20-22 |
| **September** | | |
| Oceans 2010 | Seattle, WA | 20-24 |
| ASDSO Dam Safety | Seattle, WA | 19-23 |
| **October** | | |
| USCID | Fort Collins, CO | |
| Solar Power International | Los Angeles, CA | 12-14 |
| ISSW 2010 | Lake Tahoe, CA | 17-21 |

Visit our website for training class schedules and additional listings.


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CAMPBELL® SCIENTIFIC
WHEN MEASUREMENTS MATTER

## Monitoring Bridge Expansion in Louisiana

Continued from p. 5

The purpose of the system is to measure stresses (strains) in bridge members and compare them with predicted responses during the bridge-widening construction process.

This is accomplished by:

- Establishing limits for predicted response for staged construction
- Accounting for baseline fluctuations (traffic/locomotive loads and temperature effects)
- Comparing measured with predicted response
- Automated flagging of limits outside of predicted response

The system runs continuously and collects data approximately once every ten minutes. It posts the data to a password-protected website. The website visually flags (by color) data that are outside predetermined limits.

With hundreds of vibrating-wire sensors involved, this monitoring project provided an appropriate setting to apply the new spectral-analysis method. The outcome was very positive. Historically, an application with so many vibrating-wire measurements would require extra effort to validate measurements and identify noise-compromised data. Typically, some data would be lost due to noise interference. In this case, however, spectral analysis eliminated noise issues. No data were lost, and no extra effort was needed to identify noise-compromised data.

The diagnostics provided by the new method also proved to be beneficial, and have been used extensively throughout the project. CTLGroup reported that troubleshooting issues could not have been as easily resolved without the AVW206. Though they have previously used time-domain solutions, this experience has put them solidly behind the spectral analysis method.