CAMPBELL SCIENTIFIC UPDATE

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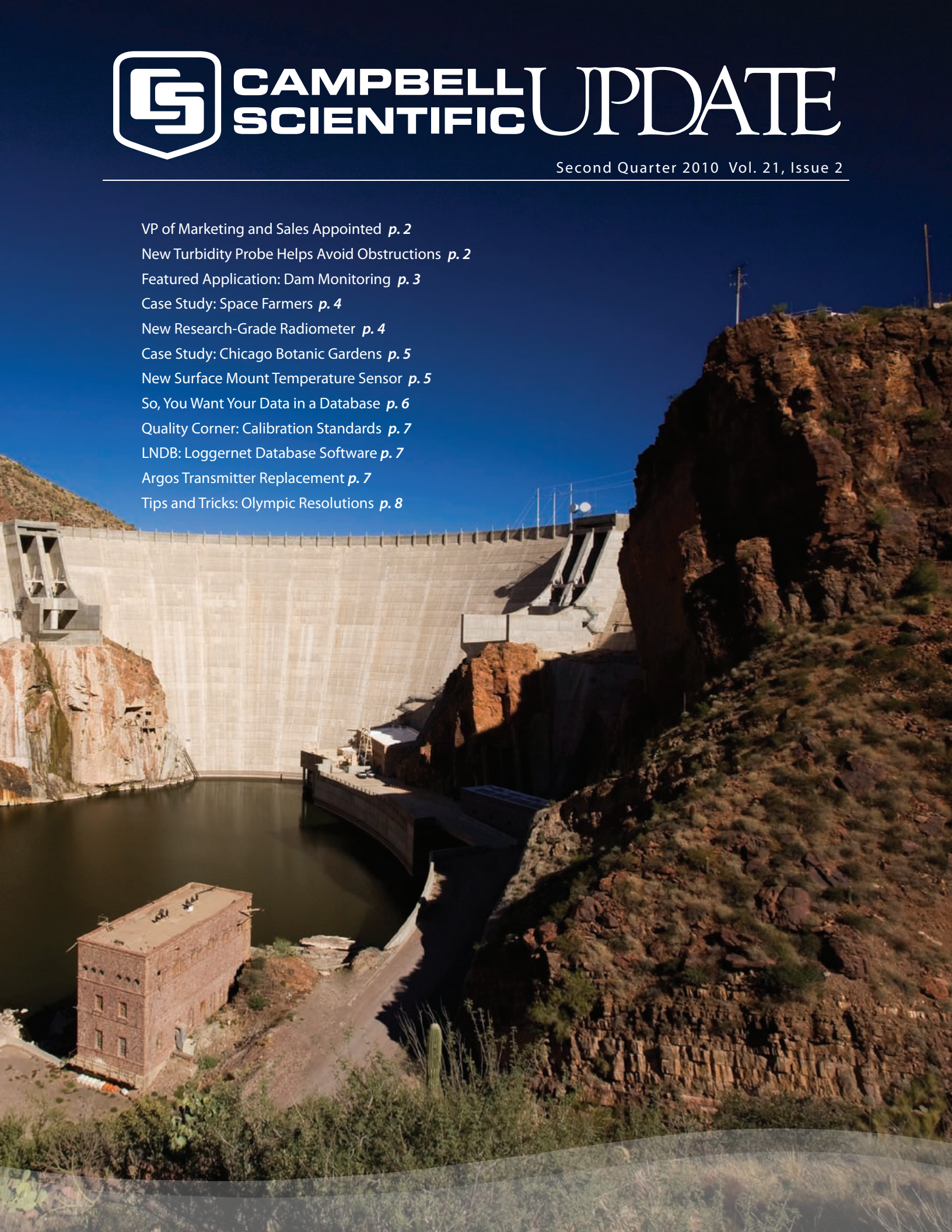


VP of Marketing and Sales Appointed

In January 2010, Joshua Campbell was appointed vice president of marketing and sales of Campbell Scientific, Inc. In this position, Joshua will be the corporate officer primarily responsible for customer relations, marketing communications, sales, application engineering, and support. Joshua has served on the board of directors since 2002 and was the manager of the Domestic Sales group from 2008 to 2010. He began his affiliation with Campbell Scientific in 1997, working part time while attending Utah State University.

From a young age, Joshua has had a keen interest in the company. While earning a master's degree in business administration, Joshua's complementary work efforts were focused on helping manage the construction and paying subcontractors for Campbell Scientific's 43,000-square-foot manufacturing facility, completed in 2000. After completing the coursework for an advanced degree in biometeorology, he became a full-time technical sales representative for Campbell Scientific.

A key learning experience came shortly after Joshua started, when he turned down a sale of several hundred thousand dollars worth of equipment because it became obvious to him that the customer would be better served with an alternative solution. It was then that the corporate philosophy that, "Our customers must be better off with our products and services than they were with their money," came into focus. "We must recognize that the long-term relationship that develops between customers and sales-and-support staff is based upon this principle being honored," says Joshua. That understanding helped Joshua as he established many key customers in his assigned sales territory, northeastern USA. Among his notable projects are an oyster-research facility at the University of Maryland and a meteorology network at the US Army Aberdeen Proving Ground, both requiring extensive configuration of measurement-and-control systems.

Joshua became a member of the American Meteorological Society (AMS), and in 2005, Bert Tanner, the previous vice president of marketing, encouraged Joshua to finish the thesis for his master's degree. Joshua took a leave of absence from work and focused his efforts on the completion of his thesis. Under the supervision of Dr. Robert R. Gillies, Joshua was able to complete his thesis, A comparative simulation of net ecosystem exchange (NEE) CO2 fluxes for two stomatal-resistance formulations over corn and soybean canopies, and received his masters in biometeorology from Utah State University.

In 2008, Joshua was promoted to manager over the Domestic Sales group. Under his leadership, the group was expanded to a team of six, with individual territorial assignments within the USA. As vice president of marketing and sales, Joshua's top priority is to continue to develop the capabilities of Campbell Scientific's technical sales and support team while maintaining the high level of market expertise and service that customers have become accustomed to over the past 35 years. Says Joshua, "The company's success in meeting customer expectations has been largely dependent on individual expertise and performance. We hope to continue this time-honored tradition of specialized support and serve our customers even more effectively as we continue to grow."

New Turbidity Probe Helps Avoid Obstructions

Campbell Scientific will soon offer the OBS300, a turbidity probe with optics located at the end of its body. Like the OBS-3+, the new OBS300 uses the innovative optical backscatter method for monitoring suspended sediment and turbidity. With this method, the probe uses its optics to emit a near-infrared light into the water. It then measures the light that bounces back from the water's suspended particles. If an obstruction is in the emitted light's range, the light will scatter back and the turbidity reading will be too high.

The location of the OBS300 optics allows you to avoid obstructions around the sides of the probe (see graphic). The OBS-3+ has optics on the side of its body, which allows you to avoid obstructions above or below the probe.

Featured Application:

Dam Monitoring

Dams are an important part of our infrastructure and provide us with many benefits, including water, power, flood control, and recreation. The National Inventory of Dams shows that in the United States alone there are more than 82,600 dams. The Association of State Dam Safety Officials (ASDSO) reports that over 3300 of these dams are classified as deficient (meaning they are susceptible to failure). Close to 17% of the dams in the U.S. are classified as having high-hazard potential—meaning failure could result in loss of life. These numbers highlight the importance of effective maintenance and upkeep of dams to ensure safe and reliable operation.

Fortunately as dams have increased in number and age, tools for facilitating their maintenance have also increased in capability. Automated monitoring systems have become an important part of many dam maintenance programs. These systems usually consist of sensors, dataloggers, and telemetry equipment that work together to measure critical parameters and provide data logging, reporting, control, and alarms.

Data can be logged over time to provide information regarding the effects of aging, earthquakes, erosion, storm events, and other variables on the overall health of the dam. Alarms and callouts can be programmed to warn engineers of potential failures. Most important of all, these systems provide 24/7 monitoring and allow detection of many changes that could otherwise go unnoticed.

Common causes of dam failure include overtopping, foundation problems, structural problems, and piping (internal erosion due to seepage). With an effective monitoring program, these causes can be detected early and repaired or mitigated. Due to the number of factors involved (hydrological, geotechnical, structural, and power related), a wide variety of measurements are required for dams. These cover everything from the structure of the dam, to the dam's foundation, to the water in the reservoir.

- Structure of the dam—cracks and joints, tilt, inclination, stress, strain, deformation, and seepage flow
- Foundations holding the dam in place—pore pressure, slope stability, subsurface water table, regional versus local tilt measurements, and subsurface rock mass deformation
- Water in (and upstream of) the reservoir—level and flow, rainfall

Over the years, our monitoring systems have provided reliable solutions for all types of dams—embankment and concrete, new and existing. A number of factors have contributed to the selection of Campbell Scientific systems. Our systems are flexible enough to measure the wide variety of sensors used in dam monitoring applications. Their low power requirements and rugged design allow them to operate unattended in harsh environments for long periods of time. Telemetry options provide real-time data and alarms to assist in remote management.

We've also released a number of products in recent years that facilitate dam monitoring. The AVW200 is a measurement interface that eliminates external electromagnetic noise that often plagues vibrating-wire measurements. The CS450 is our new submersible pressure transducer that provides measurement accuracy to .05%. Our new RF450 radios provide long-distance transmission ranges without the need for an FCC license.

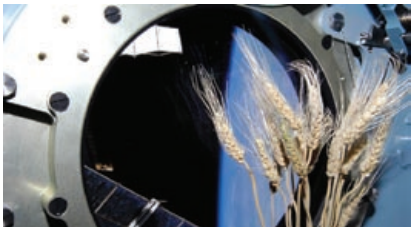
With over 40,000 dams that are 50 years old or older, the need for reliable monitoring systems will only increase. We look forward to facilitating effective monitoring through product development and application support. Don't hesitate to contact us if you have questions about your dam monitoring application.

The AVW200 is an interface that eliminates the effects of external electromagnetic noise on vibrating-wire measurements.

Space Farmers

Imagine the bored mind of a space traveler as he looks around the room he has spent months in, seeing again the same high-tech equipment he has been looking at since he left Earth. Then imagine his pleased reaction when his eyes come across a leafy, green garden, and he moves over to pick some lettuce and peas for his lunch. Later, he spends some relaxing time tending the garden, and the worries of the day fade.

This isn't futuristic science fiction. For eight years, the Russian module of the International Space Station (ISS) has hosted a plant-growing experiment that has a Campbell Scientific measurement and control datalogger at its heart. The Space Dynamics Laboratory (SDL) of Utah State University designed and built this growing chamber, named Lada for the ancient Russian goddess of Spring. Russian cosmonauts have been using it continuously since 2002 to study plant growth in space. They have grown lettuce, peas, radishes, and barley, with the dual purposes of research and food production. The suitcase-sized plot has produced a small but steady supply of vegetables since it was installed. And the research has produced valuable knowledge about reproducing plants and seeds in microgravity, important knowledge for future long-duration space missions.



The control center of the experiment consists of a CR10X datalogger and two AM25T multiplexers that monitor a huge number of soil- and air-temperature and water-content measurements, and control the growing environment in the plant chambers. About half of the plant production is eaten by the cosmonauts, and the rest is sent back to labs on Earth for analysis. The research has produced multiple generations of crops from seeds grown in space, showing the viability of continued plant production on long space journeys.

Another benefit of the Lada module is the psychological benefits people reap from working on the project. SDL engineer Shane Topham noted that after it was learned that working with the plants had a calming effect on the cosmonauts, extra time working with Lada was assigned during stressful periods at the ISS. "If they can use that as a psychological tool to help regulate the worry or difficulties psychologically then that's a very good benefit to having plants in space, independent of the food."

The latest Lada components were launched in January 2010, and are scheduled to continue on the ISS through 2012. The research has laid a foundation for improving the quality of life for space travelers on long-term missions to come.

New Research-Grade Net Radiometer

In March 2010, the CNR4 replaced the CNR1 and CNR1-L. Like its predecessors, the new CNR4 is a rugged net radiometer from Kipp & Zonen consisting of a pyranometer and pyrgeometer pair that faces upward and a complementary pair that faces downward. Its upper pyrgeometer has a meniscus dome that allows water droplets to easily roll off of it, and increases the field of view to nearly 180° instead of the 150° field of view you get with a flat window.

With the CNR4, each pyranometer and pyrgeometer is individually calibrated for optimal accuracy. The CNR4 also weighs less than its predecessors and contains both an internal thermistor and an internal platinum resistance thermometer (PRT). This radiometer does not include a heater, but the optional CNF4 ventilation and heating unit is available for customers who are concerned about dew or frost forming on the domes. The CNF4 easily attaches to the CNR4.

Chicago Botanic Garden

The 385-acre Chicago Botanic Garden welcomes more than 750,000 visitors each year. Its new Daniel F. and Ada L. Rice Plant Science Center provides laboratories and teaching facilities for more than 200 researchers, including PhD scientists, land managers, students, and interns. The Plant Science Center was designed to achieve the US Green Building Council's gold rating for Leadership in Energy and Environmental Design (LEED).

Combining the Botanic Garden organization's commitment to plant study with a desire to add practical benefits and public education, 16,000 square feet of the center's roof was built as a green-roof garden. The roof garden benefits the building by adding insulation and absorbing sunshine, which lower the cooling requirements of the building. It also captures and holds storm-water runoff that can then be used for landscape watering. The garden benefits the program side of the Chicago Botanic Garden by functioning as a research site. There the staff can study plants to find out which of them work well in rooftop gardens.

This rooftop laboratory is equipped with a variety of sensors. They monitor:

- Indoor air temperature just below the roof decking
- Outdoor air temperature above the soil and above the mezzanine roof
- Soil temperature at various depths and in the roof insulation
- Soil heat flux
- Solar radiation
- Humidity and wind above the mezzanine roof
- Precipitation

Adams Environmental Systems, with 37 years of monitoring experience, partnered with the construction company and with the scientists at the garden to design this extensive system. They installed more than 50 sensors, and used three Campbell Scientific dataloggers and two AM25T multiplexers to collect and transmit the data.

By designing a configuration that uses two CR800 dataloggers in different parts of the garden and then connecting them to a CR1000 in the roof equipment room, Adams Environmental avoided having to run cables from each sensor across the roof to one datalogger. This saved over $8,000 in system cable costs alone, not including the additional conduit and the labor costs to install it.

The CR1000 datalogger connects to the building's Ethernet network, which provides the communication infrastructure for LoggerNet to collect and display the data. By analyzing the information generated, researchers can determine the benefits of different types of roof gardens. They can also compare results from different soil-bed thicknesses, different amounts of water, and, most importantly for their program, different types of plants. With so much data made available, designers of rooftop gardens will be able to learn from these experiments as they work on other gardens. Like they say at the Chicago Botanic Gardens, "Save the plants. Save the planet."

CAMPBELL SCIENTIFIC UPDATE

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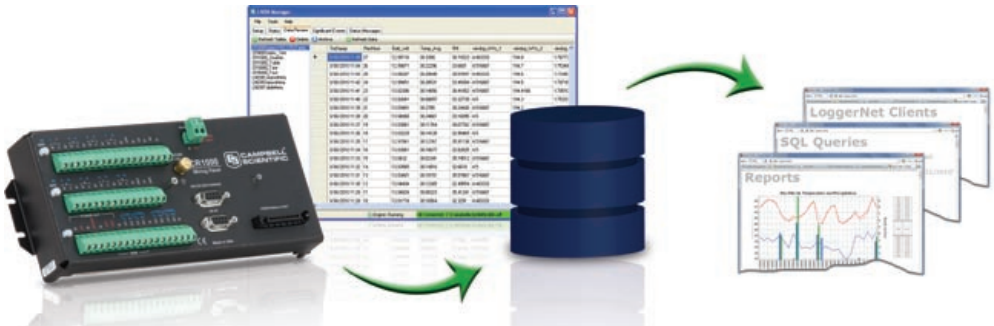
New Surface Mount Temperature Sensor

The CS220 is a 24-AWG, type-E thermocouple, typically used for temperature measurements on the back of a solar panel. For temperatures up to 260°C, this fast-response thermocouple adheres to the panel. For temperatures up to 315°C, the CS220 can be cemented to the panel using epoxy. The thermocouple's tolerance (reference junction at 0°C) is 1.0°C or 0.4 percent (0° to 900°C).

So, You Want Your Data in a Database



If you have a network of Campbell Scientific dataloggers, you have data. And if you have data, you may be looking for a way to manage those data. Users often turn to databases when looking for a data management solution.

Databases have a lot to offer. All of your data are in one place. The consistency of the data is increased, while redundancy is reduced. Managing large amounts of data is accomplished more efficiently in a database than in a file-based system. Databases don't come without their challenges, however. They can be complex and difficult to design. If a database becomes damaged or corrupted, all data and applications dependent upon that database are affected. There are also the costs of user training and of moving your data from a file-based system to a database-backed system.

As a Campbell Scientific customer, you know our products are flexible and we often offer more than one way to get something done. Databases are no exception. If you have weighed the pros and cons and have decided that a database system is for you, you'll want to explore the options below.

LNDB

LNDB is a new LoggerNet client application that copies data from the LoggerNet server's data cache into a database. LoggerNet's data cache is updated by enabling scheduled data collection with the dataloggers in the network. The LNDB engine then populates the database with the data collected from the dataloggers. The LNDB engine runs as a service. If you employ LoggerNet Admin running as a service, the operation can run unattended without the need for a user to log on to the computer system for the database to be updated. The first release of LNDB includes tools to port the datalogger data to a database, view the database table structure, import or export data, and archive the data. (See the full LNDB article for more information.)

Data Export

Data Export is a client application that is installed with LoggerNet Admin. It provides a way to export data collected by LoggerNet to another application via TCP/IP. Data Export opens a socket and begins listening on that socket for a request from an application to send data. When a request is received, data from the LoggerNet data cache are exported in an ASCII format. (Our older RTMS format is also supported.) The receiving application handles importing the data into the database or storing the data to a file. This option requires development of the application that will request data from Data Export.

File Import

LoggerNet supports storing data in a variety of file formats, including comma separated values and XML. Depending upon the database being used, ASCII or XML data can be inserted into a table using an Insert, BulkInsert, LoadInto, BulkLoad, or a similar command. This option requires significant database programming skills.

VisualWeather

VisualWeather is an application that was designed to support our preconfigured weather stations (custom weather stations are also supported). Using a setup wizard, the weather stations are defined and scheduled data collection is set up. Collected data are saved as a file and are also stored in a database. The database can then be queried using a variety of predefined and custom reports that take advantage of the features offered by the flexibility of having your data in a database. The database used in VisualWeather is not accessible by other database tools.

Third Party Tools

In addition to the products offered by Campbell Scientific, some third parties offer database products that support our dataloggers. Two of these options are listed below.*

- **Vista Data Vision** is an application developed by Vista Engineering. Vista Data Vision imports data from DAT files and stores the data into a MySQL database. The data can then be viewed locally or on the web in a variety of configurable tables and graphs.
- **EQuIS** is a comprehensive data management system developed by EarthSoft. EQuIS imports DAT files and stores the data into

Continued on page 8

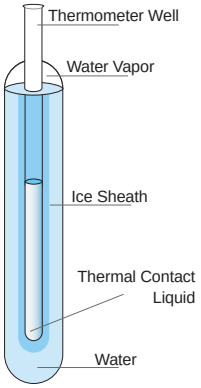
Quality Corner: Calibration Standards

Our slogan here at Campbell Scientific is, "When measurements matter." Making good measurements has been important to us from the beginning. Calibration is an important part of ensuring accurate measurements. To calibrate any piece of equipment, a standard with known accuracy must be used for comparison. Most calibration standards that we use have traceability to the National Institute of Standards and Technology (NIST). The NIST traceability of these standards is essential to ensure the validity of the measurements and comparisons made, and to ensure that the accuracy is within acceptable limits.

In some cases a physical standard can be used for calibration as long as it exhibits a natural characteristic that is constant and repeatable. One such standard is the triple point of water—the temperature (0.010°C) at which water can exist as a solid, liquid, and gas. Using a triple-point-of-water cell, the three phases can be realized and the physical standard can then be used for calibration, with an accuracy of ±0.0001°C.

For example, we use the triple point of water for calibrating our 105E thermocouples. It serves two very useful purposes for this. First, it gives us a known temperature (0.010°C) that we can create for the reference junction of the thermocouple using our triple-point cell. Second, we use it to validate our platinum resistance thermometer (PRT) that we use on the measurement junctions of the 105E thermocouples during calibration.

Our triple-point cell and PRT are just two of the instruments we have at Campbell Scientific to ensure that our products meet your needs. Whether we calibrate our products to an NIST-traceable standard or to a reliable physical standard, we are conscientious about the measurement accuracy of our products and are dedicated to maintaining a high degree of overall measurement quality.

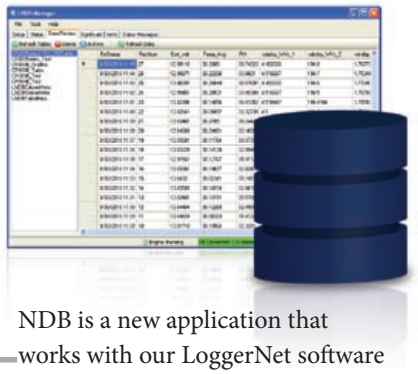


A triple-point cell: The triple point of water (0.010°C), at which water exists in solid, liquid, and gas form at the same time, is used to calibrate thermometers and thermocouples.

Argos Transmitter Replacement

Coming soon from Campbell Scientific is the ST-21, a new Service Argos platform transmitter terminal (PTT). Polar orbiting satellites make the Argos system well suited for stations deployed in high latitudes. The new ST-21 consists of a Telonics electronics module, a voltage regulator, and an SDC communication interface—all housed in a rugged metal case. It has low power drain and a wide operating temperature range (-30° to +70°C).

LNDB: LoggerNet Database Software



LNDB is a new application that works with our LoggerNet software to easily move data to a relational database. Storing your data in a database provides significant advantages. (See related article in this issue.)

LNDB has two main components: LNDB Manager and LNDB Engine. LNDB Manager is used to set up a database and select the datalogger data tables that will be stored in the database. It also allows you to determine what happens if datalogger data tables change. LNDB Manager also provides tools to monitor the LNDB Engine and to review the database data. LNDB Engine runs as a service and sends the selected data from the LoggerNet data cache to the database. Additionally, LNDB includes utilities for importing and exporting data. LNDB ships with Microsoft SQL Server Compact, and also supports Microsoft SQL Server Express and MySQL.

Campbell Scientific will be adding to our database capability in the near future. The next version of LNDB will include QuickReports, a simple report generator that will allow the user to create reports containing a graph and table display. Other future enhancements include integration with RTMC Pro and View Pro.

Tips and Tricks: Olympic Resolutions

Did you watch the Winter Olympics? I sure did. The competition was amazing! Races were determined by hundredths, even thousandths of a second. Those measurements needed to be accurate and precise and had to be reported with enough resolution to determine the winner.

At Campbell Scientific, we know a lot about making measurements. When making measurements and reporting data it is important to understand the following factors:

- What you are measuring
- The specifications of the tools you are using (sensors and dataloggers)
- The project needs

Campbell Scientific dataloggers allow you to specify different resolutions for your data when you program the datalogger. In CRBasic, you have the output option of FP2 (low resolution) or IEEE4 (high resolution), among others. FP2 is adequate for most stored data. Some measurements, such as barometric pressure in millibars, need to be stored in IEEE4. For our Edlog dataloggers, instruction P78 specifies low or high resolution. See the box below for programming examples.

Some questions to ask yourself when deciding on the resolution of your output:

- Does this make sense in the environment being measured?
- Do the sensor's specifications warrant this level of resolution?
- Is the datalogger programmed to respond to this level of resolution?
- How much resolution is needed to do the job?

The objective of a data acquisition system should be to produce data with high accuracy, high precision, and the appropriate resolution for the given application. Luge races are timed to the thousandth of a second, super-G to the hundredth, and biathlon to the tenth. Which race are you in?

Go for the gold!

Tip

Setting Resolution in CRBasic Dataloggers

```
Sample (1,Pressure,IEEE4)
Sample (1,PTemp,FP2)
```

Setting Resolution in Edlog Dataloggers

```
11: Resolution (P78)
    1: 1 High Resolution
12: Sample (P70)
    1: 1 Reps
    2: 1 Loc [ Pressure ]
13: Resolution (P78)
    1: 0 Low Resolution
14: Sample (P70)
    1: 1 Reps
    2: 2 Loc [ PTemp ]
```

Database

Cont'd from page 6

databases. The data can then be integrated with a variety of modeling and analysis tools, such as ArcGIS, RockWorks, EnviroInsite, GMS, LogPlot, EVS, or LakeWatch. EQuIS provides desktop and web hosted solutions.

Questions?

Brochures and manuals for our products can be found on our website. If you have questions about LNDB, VisualWeather, or LoggerNet, contact Campbell Scientific.

Vista Data Vision is supported exclusively by Vista Engineering (website: www.vistadatavision.com) and EquIS is sold and supported by EarthSoft (website: www.earthsoft.com).

* Other third party options may be available.

Trade Show Calendar

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
July		
IABMAS 2010	Philadelphia, PA	11-15
Hydrovision International	Charlotte, NC	27-30

Visit our website for training class schedules and additional listings.

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